J. mar. biol. Ass. India, 1987, 29 (1 & 2) : 195-200

BREEDING OF WOOD BORING SPHAEROMATIDS IN THE MAJOR LAKES OF KERALA, INDIA

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ABSTRACT

Comparative study of the breeding activity of *Sphaeroma terebrans* in the three major brackish-water lakes of Kerala viz., Vembanad, Ashtamudi and Veli Lakes and *S. annandalei* in the Ashtamudi Lake, in relation to the environmental factors in these lakes, showed that both the species are continuous breeders. Lower temperature tended to increase the breeding activity of *S. terebrans* whereas in *S. annandalei* higher temperature favoured the breeding activity. Higher levels of oxygen appeared to enhance the breeding activity of *S. terebrans*. Significant, multiple correlation was seen between the nutrients and breeding activity of both the species.

INTRODUCTION

PREVIOUS studies on the breeding of wood boring Sphaeromatids in the Kerala waters (Pillai, 1961; Cheriyan, 1964, 1972 ; Nair, 1965; Dharmaraj and Nair, 1979) have been carried out in limited ecological niches only, as part of a general study on their biology and seasonal abundance. Since a comparative study of the breeding activity in the different habitats would only provide the true picture of the factors governing their breeding, the present study was undertaken in the three major brackishwater lakes *i.e.*, Vembanad, Ashtamudi and Veli Lakes of Kerala.

Vembanad Lake (9°30'—9°58' N ; 75°15'—76°25'E) is the largest lake of the State receiving the discharges from five major rivers. It has permanent outlet into the sea and a natural harbour at the mouth and dense human population on the banks giving rise to a high level of pollution.

Ashtamudi Lake (9°28'—8°45' N ; 76°28'—77°16' E) is the second largest lake of the State joined only by a single river and having a permanent outlet into the sea. It has lesser density of human population along the banks.

Veli Lake (8°28' N ; 78°58' E) is the smallest of the three lakes without any major rivers opening into it. During the summer months, the lake is separated from the adjoining sea by the formation of a sand bar which disappears during the monsoon and result in the continuity of the lake with the sea.

Water and faunal samples for the study were collected from 3 fixed stations, about 5 km away from the bar mouth in the case of Vembanad Lake, 3 km in the case of Ashtamudi Lake and about ½ km in the case of Veli Lake.

METHODS

The material for hydrological study was constituted by fortnightly surface water samples, between June, 1978 and May, 1980. Dissolved oxygen, salinity, pH, nitrate, nitrite, inorganic phosphate and silicate were determined by standard methods (Grasshoff, 1976). Water

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TABLE 1. *Monthly distribution of the hydrographic factors and the breeding activity of* S. terebrans *in the Vembanad Lake*

Month	Water Temperature (°C)	Oxygen (ml/l)	pH	Salinity (‰)	Rainfall (mm)	Nitrate (μg–at. NO_3 N/l)	Nitrite (μg–at. NO_2 N/l)	Phosphate (μg–at. PO_4 P/l)	Silicate (μg–at. SiO_4 Si/l)	Percentage of the ovigerous females and young once in the total population
I Year										
June	27.9	4.06	7.05	1.40	925.2	1.58	1.88	3.00	24.88	80.6
July	28.0	3.80	6.90	4.66	651.8	7.00	8.75	19.50	140.00	48.9
August	29.4	4.50	7.15	0.50	454.9	13.50	10.50	39.00	41.40	6.3
September	30.6	7.10	8.50	1.80	280.8	4.00	8.00	10.50	17.00	43.8
October	30.2	5.40	6.80	0.90	335.1	0.25	1.25	7.33	31.00	61.5
November	31.8	4.20	7.30	2.00	359.3	12.06	1.14	13.84	26.37	60.4
December	31.8	6.04	7.10	13.40	32.1	1.48	1.62	12.00	43.10	62.2
January	28.2	6.90	8.30	20.50	13.5	0.09	0.18	3.00	22.22	66.3
February	31.8	5.10	7.75	24.50	28.6	1.14	1.11	6.00	34.55	59.4
March	31.8	3.66	7.90	25.00	4.6	0.42	1.58	7.50	29.10	60.0
April	32.8	2.21	7.70	23.50	36.4	3.46	1.04	12.00	46.55	63.3
May	32.0	4.17	7.10	19.20	102.3	0.59	0.53	7.71	34.84	50.0
II Year										
June	30.2	3.66	7.20	0.80	1138.0	2.16	20.50	24.75	15.00	51.8
July	29.4	3.10	7.10	0.80	653.8	0.67	5.00	32.00	53.03	55.6
August	29.2	4.85	8.00	2.30	327.4	0.41	1.57	14.14	23.33	39.0
September	29.0	4.08	7.02	2.00	334.3	0.59	0.26	0.64	21.33	53.0
October	30.5	5.36	6.80	1.80	273.8	1.34	0.26	2.25	9.99	48.6
November	30.8	3.90	6.90	2.60	252.2	3.72	1.28	18.40	32.85	56.8
December	30.5	4.29	7.75	21.00	0.0	0.13	0.83	2.57	7.14	60.0
January	29.5	4.74	7.85	22.30	0.0	0.13	0.53	4.88	9.09	56.1
February	30.5	4.85	7.80	25.00	3.4	0.12	0.36	1.50	10.10	52.9
March	32.5	3.50	7.60	24.25	33.0	0.90	0.75	6.00	19.00	50.0
April	32.8	2.85	7.60	29.50	71.1	0.98	0.80	4.50	25.44	59.3
May	31.5	3.55	7.50	13.00	40.5	0.90	1.00	5.60	33.50	47.2

TABLE 2. *Monthly distribution of the hydrographic and the breeding activity of* S. terebrans *and* S. annandalei *in the Ashtamudi Lake*

Month	Water Temperature (°C)	Oxygen (ml/l)	pH	Salinity (‰)	Rainfall (mm)	Nitrate (μg—at.NO_3-N/l)	Nitrite (μg—at. NO_2-N/l)	Phosphate (μg—at. PO_4-P/l)	Silicate (μg—at. SiO_4-Si/l)	Percentage of the ovigerous females and young once in the total population	
										S. terebrans	*S. annandalei*
I Year											
June	28.4	4.82	7.90	12.60	348.0	1.50	0.50	2.50	35.00	77.8	52.9
July	28.2	5.84	8.00	21.30	345.0	0.25	0.13	3.00	58.33	65.9	68.2
August	27.8	4.40	7.50	7.20	339.0	1.63	0.63	1.20	37.17	62.3	61.9
September	27.2	4.30	7.80	29.50	108.0	1.38	0.50	12.00	15.00	67.3	27.2
October	29.8	4.96	7.85	16.30	228.0	0.25	0.25	1.66	50.00	68.5	40.9
November	26.8	5.65	7.80	18.30	724.0	1.15	0.29	1.84	55.50	60.8	58.0
December	27.0	3.69	7.95	33.00	11.0	0.29	0.54	3.00	11.20	80.8	65.5
January	28.2	3.95	8.05	32.90	0.0	1.01	0.55	8.10	21.32	70.5	68.3
February	30.8	2.42	7 90	28.80	20.0	1.01	0.10	1.05	31.47	61.8	68.9
March	32.2	1.65	7.75	33.30	0.0	1.30	0.13	2.63	21.52	57.6	79.3
April	31.9	2.20	8.05	34.20	64.0	0.37	0.13	1.60	24.13	67.0	83.8
May	31.6	2.70	7.70	35.60	83.0	0.25	0.13	11.29	27.29	58.2	71.3
II Year											
June	29.0	3.52	7.50	14.25	503.0	0.50	0.50	3.00	60.00	73.8	69.7
July	25.8	2.87	7.85	33.00	246.9	0.20	0.13	1.50	22.72	64.5	60.0
August	29.2	3.70	7.50	6.50	160.2	0.10	0.26	1.29	26.66	58.9	67.7
September	29.5	3.39	7.70	16.00	166.1	0.30	0.13	1.29	26.66	45.9	58.7
October	28.0	4.09	7.85	34.00	150.1	0.27	0.53	1.88	14.28	60.3	85.4
November	28.2	4.80	7.90	11.20	386.0	0.74	0.26	1.60	78.57	74.9	76.1
December	29.0	3.78	7.75	32.80	69.0	0.08	0.28	2.57	11.43	86.2	69.0
January	29.0	4.17	7.90	30.00	0.0	0.33	0.03	0.75	13.63	67.5	76.8
February	31.5	3.27	7.85	30.30	3.7	0.03	0.05	1.50	15.00	58.0	64.6
March	31.0	2.50	7.65	35.00	0.0	0.25	0.30	2.70	18.00	60.3	65.8
April	31.0	3.05	7.90	29.21	70.0	0.10	0.08	1.70	16.55	53.5	64.5
May	31.2	3.49	7.85	32.60	33.0	0.60	0.40	1.95	28.10	44.0	72.7

TABLE 3. *Monthly distribution of the hydrographic factors and the breeding activity of* S. terebraus *in the Veli Lake*

Month	Water Temperature (°C)	Oxygen (ml/l)	pH	Salinity (‰)	Rainfall (mm)	Nitrate (μg—at. NO_3-N/l)	Nitrite (μg—at. NO_2 N/l)	Phosphate (μg—at. PO_4 P/l)	Silicate (μg—at. SiO_4Si/l)	Percentage of the ovigerous females and young ones in the total population
I Year										
June	28.0	7.10	7.50	4.85	209.8	2.85	1.08	1.83	102.00	56.8
July	27.6	4.58	6.80	0.40	189.6	3.25	1.25	1.50	89.00	79.8
August	27.4	4.50	7.10	0.60	179.8	2.25	0.75	1.50	67.10	73.4
September	31.2	5.98	7.55	0.60	46.8	0.13	0.25	1.88	32.00	54.4
October	29.8	4.01	7.95	0.80	57.8	0.75	1.00	1.33	90.00	65.7
November	27.5	4.91	7.10	6.00	676.3	1.92	2.28	0.92	63.84	69.3
December	28.2	4.00	6.65	0.30	117.0	0.35	0.27	0.50	77.50	47.7
January	30.0	5.22	7.75	1.20	0.0	1.26	5.52	2.14	88.25	67.2
February	31.4	4.54	7.50	0.60	98.3	0.47	0.28	1.05	118.00	58.3
March	31.9	6.50	8.40	3.40	35.8	2.74	5.26	1.13	90.10	60.8
April	32.0	5.40	8.30	3.00	57.4	0.21	0.29	1.20	60.11	56.9
May	33.2	7.22	8.95	2.80	97.0	1.00	13.00	3.43	71.97	38.2
II Year										
June	30.0	3.47	6.85	2.80	338.0	4.00	3.50	3.00	37.40	57.1
July	28.0	4.60	7.00	2.00	185.0	0.13	0.79	1.50	42.42	66.2
August	28.6	3.95	7.00	1.20	131.8	0.44	0.39	0.43	16.66	82.0
September	29.8	4.00	6.65	0.40	212.7	0.76	0.53	0.21	10.66	46.5
October	30.7	4.90	7.40	0.40	57.0	0.26	1.32	0.38	27.14	58.5
November	28.0	1.64	6.40	0.60	375.4	0.04	1.28	0.40	31.13	81.8
December	29.5	5.65	7.55	1.25	63.9	0.71	1.67	1.93	28.57	78.1
January	29.5	3.50	7.20	2.10	0.0	0.02	2.10	0.75	43.93	79.2
February	31.0	5.30	7.30	2.40	0.0	0.03	0.06	0.85	45.00	63.1
March	32.5	4.57	7.65	3.25	16.4	0.50	1.20	0.80	48.00	64.5
April	32.5	4.77	7.70	4.45	67.6	0.60	0.30	1.08	56.00	61.5
May	30.5	6.40	7.90	2.60	132.4	0.55	0.25	2.10	29.00	57.6

temperature and transparency were measured by a centigrade thermometer and Secchi disc respectively in the field itself.

Faunal samples were collected invariably during the last week of the months during the study. Because of the small size of the animal, it was difficult to make the necessary measurements and the breeding activity on the gonad index and so the method followed by Onbe (1966) *i.e.* counting the actual number of young ones and also the ovigerous females during a season, on the intensity of which may depend the breeding season, was followed during the present study. Specimens from the field samples indicated that both the species become sexually distinguishable, when they attain a length of about 3.5 mm. So, the animals below this cut off length were grouped as young ones. The breeding activity was assessed on the basis of the percentage of the average number of ovigerous females and young ones to the total number of animals collected from unit weight of 1 kg of submerged wood chopped off from the three stations in each of the lakes.

Correlation coefficients between the hydrographic factors and the combined strength of the ovigerous females and young ones were calculated.

Results and Discussion

The percentages of the combined strength of the ovigerous females and young ones and the hydrographic factors in each month are presented in Tables 1, 2 and 3.

The presence of ovigerous females or young ones or both throughout the year of *S. terebrans* in all the three lakes and of *S. annandalei* in the Ashtamudi Lake will show that both the species are continuous breeders. This concurs with the observations of earlier workers (Pillai, 1961; Cheriyan, 1964; John, 1969; Dharmaraj and Nair, 1979). Seasonwise, the Northeast monsoon season with the maximum level of oxygen and intermediate levels of rainfall, temperature and nutrients appear to be the most favourable season for the breeding activity of *S. terebrans* in the Vembanad and Ashtamudi Lakes. However, the breeding activity of *S. annandalei* in the Ashtamudi Lake was maximum during the pre-monsoon season and coincided with the lowest level of oxygen and rainfall and maximum temperature.

Monthwise there was significant negative correlation between temperature and breeding activity of *S. terebrans* in the Veli Lake during the first year (Corr. Coeff. -0.6422, $p < 0.05$). Similar relationship was also present between nitrate, nitrite and phosphate and breeding activity of *S. terebrans* in the Vembanad Lake in the first year (Corr. Coeff. -0.6536, -0.7823, -0.8875 and $p < 0.05$, 0.01 and 0.01 respectively between nitrate, nitrite and phosphate and breeding activity). The relationship between temperature and breeding activity of *S. annandalei* was positive in the first year (Corr. Coeff. -0.5878, $p < 0.05$).

According to multiple correlation coefficients there was significant positive correlation between the nutrients and breeding activity of both *S. terebrans* and *S. annandalei* (Corr. Coeff. between phosphate, nitrate and nitrite and breeding activity of *S. terebrans* in the Vembanad Lake in the second year 13.2413, $p < 0.01$; between nitrite, temperature and pH and breeding activity of *S. terebrans* in the Ashtamudi Lake in the first year, 4.3468, $p < 0.05$, between temperature, nitrate, pH, oxygen and nitrite and breeding activity of *S. terebrans* in the Veli Lake in the first year, 4.1592, $p < 0.05$ and between oxygen, nitrite, nitrate and pH and breeding activity of *S. annandalei* in the second year 6.8696, p 0.01).

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