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Voluntary Spawning Patterns of Captive Spotted Seatrout

John W. Tucker Jr.
Harbor Branch Oceanographic Institution

Blake E. Faulkner
Harbor Branch Oceanographic Institution

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VOLUNTARY SPAWNING PATTERNS OF CAPTIVE SPOTTED SEATROUT

During 1-26 April 1985, six female and 10 running ripe male spotted seatrout *Cynoscion nebulosus*, were collected by hook and line from the Indian River estuary near Fort Pierce, Florida. They were placed in an outdoor concrete raceway (12.2 m x 3.4 m x 0.9 m deep) supplied with sprayed, gravel-filtered water from the estuary (90-100% exchange per day). The standpipe was covered with a screen when eggs were needed. The seatrout were fed about 25% each of live pinfish (*Lagodon rhomboides*), live penaeid shrimp, frozen shrimp, and frozen bay scallops. On 21 October, the seatrout were weighed, measured, checked for ripeness, and released.

During 11-24 April 1986, seven female and 10 running ripe male spotted seatrout were placed in one raceway and one female and 10 males in another raceway. Their diet was the same as in 1985 except that frozen squid was substituted for scallops. On 20 September, the seatrout were weighed, measured, checked for ripeness, and released.

RESULTS AND DISCUSSION

1985. During April, there were 12.3-13.1 hours light per day, water temperature was 17-25°C and salinity 26-40‰. In late May, juvenile spotted seatrout were observed in the raceway. A uniform length of about 18 mm on 5 June indicated that they had been spawned about 22 days earlier, about 13 May, when there were 13.4 hours light per day (based on 18 mm length of known 22-day old larvae in raceway).

From 1 June through 21 October, the raceway was monitored closely for eggs (Table 1, Figure 1). The next recorded spawn occurred on 8 June. Water temperature was 30.5°C and there were 13.8 hours light per day. During 8 June-13 September, the seatrout spawned 41 times. Water temperature on spawning days was 27.7-32.5°C; it dropped as low as 26.1°C between spawns but did not exceed 32.5°C. Light per day ranged from 12.4 to 13.9 hours. Before 25 April and after 21 September, salinity was lower than 28‰; the range was 28-36‰ during the spawning period. When the last spawn occurred on 13 September, water temperature was 31.4°C with 12.4 hours light per day. Water temperature dropped to 25.6° on 18 September and salinity dropped from 28‰ to 23‰ on 21 September. Although temperature was 27.7-30.2°C during 21 September-21 October, salinity remained below 28‰ until 17 October, and spawning did not occur again. The sudden temperature decrease initially halted spawning, and this was reinforced by the salinity decrease. Sometime during these last four weeks, decreasing light probably became an important cue.

The most intense spawning occurred during 7-12 July and 29 August-9 September, with large numbers of eggs (>4,000,000) produced every day. Croaking sounds could be heard above the water and grunting and staccato sounds under water before and during spawning. Recordings of these sounds verified the identity of those recorded earlier in the Indian River by Mok and Gilmore (1983). Spawning frequency was low in August, possibly because of sustained high temperatures.

On 21 October, the males were 360-554 mm TL, 500-1,450 g, and the females were 428-576 mm TL, 820-1,950 g. Only two of the males were running ripe, and biopsies indicated that ovaries

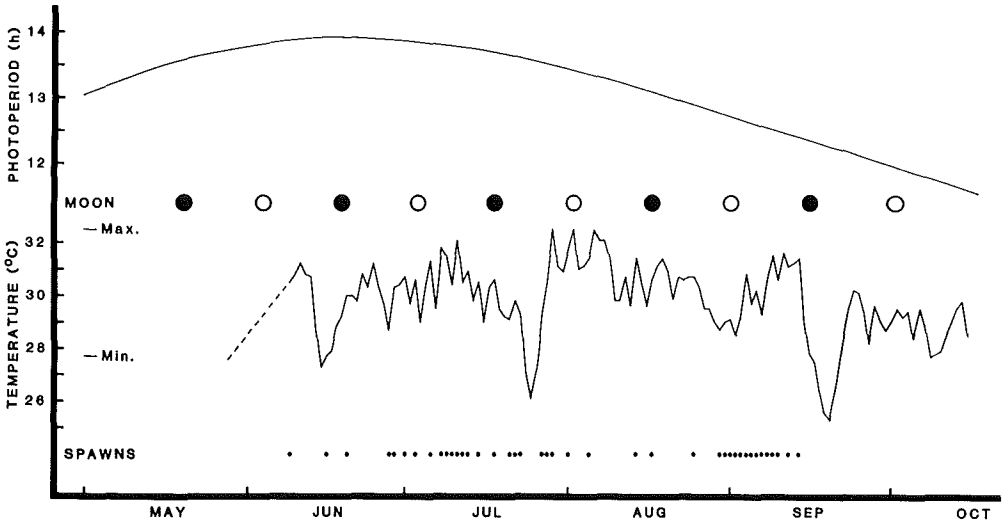

Figure 1. Spawning of captive spotted seatrout (dots) and associated environmental factors during 1985. Minimum and maximum spawning temperatures are indicated.

of all six females were spent and regressing.

1986. During a 48-day period, the group of seven females spawned 17 times and the individual three times (Table 2, Figure 2). Then, after a 47-day break, both the group and the individual spawned on two consecutive nights, skipped one night, and spawned again on the fourth. The group spawned seven more times during the next nine days. Two days before the first spawn in May, water temperature rose from 26.8°C to 28.1°C. Through the summer, temperature did not seem to vary enough to limit spawning. The range was 28.1°-31.9°C on spawning days. Temperature briefly dropped to 27.6°C

Table 1. Spawning data for captive spotted seatrout in 1985 (six females in one tank).

Spawn number	Date	Temperature (°C)	Spawn number	Date	Temperature (°C)
1	~13 May	----	22	27 Jul	30.5
2	8 Jun	30.5	23	28 Jul	32.5
3	15 Jun	27.7	24	31 Jul	31.7
4	19 Jun	30.0	25	4 Aug	31.4
5	27 Jun	28.7	26	13 Aug	31.4
6	28 Jun	30.3	27	16 Aug	30.6
7	30 Jun	30.7	28	24 Aug	30.7
8	2 Jul	30.6	29	29 Aug	28.7
9	5 Jul	31.3	30	30 Aug	29.0
10	7 Jul	31.8	31	31 Aug	29.1
11	8 Jul	31.5	32	1 Sep	28.5
12	9 Jul	30.4	33	2 Sep	29.2
13	10 Jul	32.1	34	3 Sep	30.8
14	11 Jul	30.5	35	4 Sep	29.7
15	12 Jul	30.9	36	5 Sep	30.2
16	14 Jul	30.5	37	6 Sep	29.3
17	17 Jul	30.6	38	7 Sep	30.6
18	20 Jul	29.1	39	8 Sep	31.5
19	21 Jul	29.8	40	9 Sep	30.6
20	22 Jul	29.3	41	11 Sep	31.1
21	26 Jul	29.2	42	13 Sep	31.4

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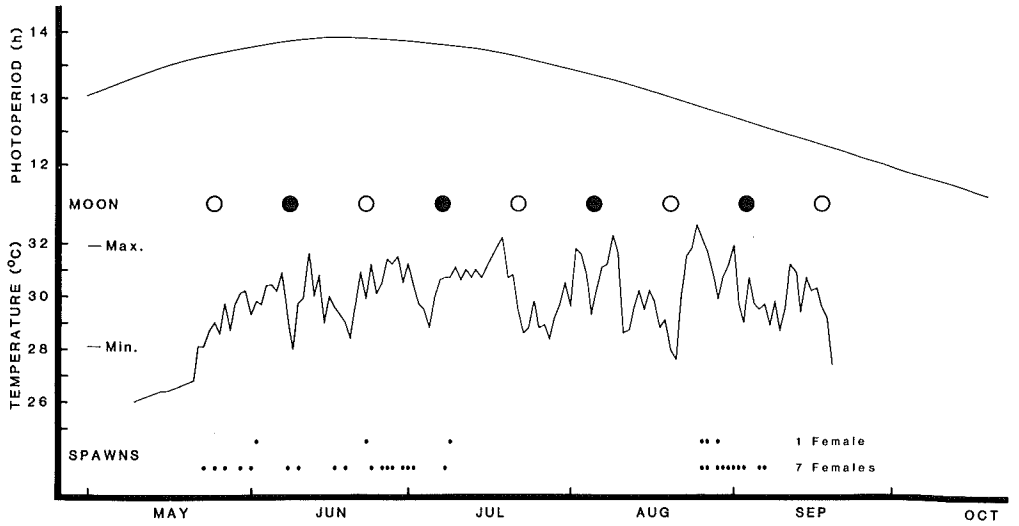

Figure 2. Spawning of captive spotted seatrout (dots) and associated environmental factors during 1986. Minimum and maximum spawning temperatures are indicated.

five days before the second spawning period began and then rose to 32.7°C the day before. After spawning ceased, temperature remained at 28.7-31.2°C, but then dropped to 27.4°C on 20 September.

During May-July 1986, the number of spawns was nearly proportional to the number of females. The individual female spawned three times at 21-day and 16-day intervals. Possibly, individual females in the group of seven also spawned three times, usually on different nights but occasionally on the same night. The first three spawns at the end of August were clearly synchronized. As in 1985, intense spawning occurred twice, during 26 June-2 July and 26 August-3 September.

Table 2. Spawning data for captive spotted seatrout in 1986 (seven females in one tank and one female in another).

Spawn number	Date	Temperature (°C)	Spawn number	Date	Temperature (°C)
Seven females					
1	23 May	28.1	15	1 Jul	31.2
2	25 May	29.0	16	2 Jul	30.4
3	27 May	29.7	17	8 Jul	30.7
4	30 May	30.1	18	26 Aug	31.9
5	1 Jun	29.3	19	27 Aug	31.7
6	8 Jun	29.3	20	29 Aug	29.9
7	10 Jun	29.7	21	30 Aug	30.7
8	17 Jun	29.6	22	31 Aug	31.2
9	19 Jun	29.0	23	1 Sep	31.9
10	24 Jun	31.2	24	2 Sep	29.7
11	26 Jun	30.5	25	3 Sep	29.0
12	27 Jun	31.4	26	6 Sep	29.5
13	28 Jun	31.2	27	7 Sep	29.7
14	30 Jun	30.5			
One female					
1	2 Jun	29.8	4	26 Aug	31.9
2	23 Jun	29.9	5	27 Aug	31.7
3	9 Jul	30.7	6	29 Aug	29.9

Table 3. Mean rainfall (mm) recorded at six stations within an 8-km radius of the water intake for spawning tanks (data provided by Frank Evans, St. Lucie County Mosquito Control District).

	1985	1986
April	163	5
May	84	46
June	76	96
July	244	300
August	102	213
September	384	147

Heavy rainfall, lowered salinity, and/or toxicants in runoff may have been factors in 1986. Before spawning began, the salinity range was 30-35‰, during the first spawning period it was 30-37‰, and during the second period, 30-31‰. The gap in spawning activity coincided with heaviest rainfall, which was higher in 1986 (Table 3). During 10-28 July, the salinity range was 27-32‰, and during 29 July-25 August, it was 27-29‰. Salinity rose to 33‰ on 11 September and dropped to 28‰ on 15 September and to 23‰ on 22 September.

On 20 September, the males with the group of seven females were 377-563 mm TL, 660-2,000 g, and the females were 420-575 mm TL, 910-2,110 g. In the other tank, males were 366-453 mm TL, 500-1,110 g, and the female was 427 mm TL, 860 g. All males were still running ripe. All females had yolked oocytes with mean diameters of 381-444 μm for the group and 420 μm for the individual.

This study has documented conditions under which Indian River spotted seatrout will spawn, and the information can be applied to management of natural and captive populations. Conditions in the raceways closely reflected those in the adjacent estuary. Except for the long gap in 1986, spawning patterns were similar. Except for the May 1985 spawn, temperatures were toward the high end of the range reported for natural spawning, 27.7-32.5°C in 1985 and 28.1-31.9°C in 1986 vs 21-35°C (Mercer 1984). Seatrout spawned over a salinity range of 28-37‰. The range was narrow in 1985 and probably did not affect spawning between 25 April and 21 September, but in 1986 a change in water quality may have been a factor during the gap in spawning from 9 July to 25 August. During both years, there were two spawning peaks, in early and late summer, as also reported from field studies (Mercer 1984). These began on 27 June and 29 August in 1985 and on 26 June and 26 August in 1986. During both years, the two periods of most intense spawning (6-12 days; Figures 1, 2) occurred between the full and new moons at the end of June and August. Adkins *et al.* (1979) also reported increased spawning after the full moon in Lousiana. Judged from embryonic development and temperature, fertilization probably always occurred between 2100 and 2230 EST (2-4.5 h after sunset). This was slightly later than spawning times reported for a Port Aransas, Texas, population (Holt *et al.*, 1985; Joan Holt, pers. comm., 16 September 1986). Eggs always had a single oil globule, and hatching rate was 99.9-100.0%. If the fish had been stocked earlier, they might have started spawning sooner. A relatively steady supply of eggs for experimental or aquacultural purposes probably can be produced in other areas during the natural spawning season by using similar methods. Spotted seatrout can be spawned by use of hormones (Colura 1974), indoor conditioning (Arnold *et al.* 1976), or outdoor conditioning (this paper).

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John W. Tucker, Jr. and Blake E. Faulkner, *Harbor Branch Oceanographic Institution, 5600 Old Dixie Highway, Ft. Pierce, FL 33450.*