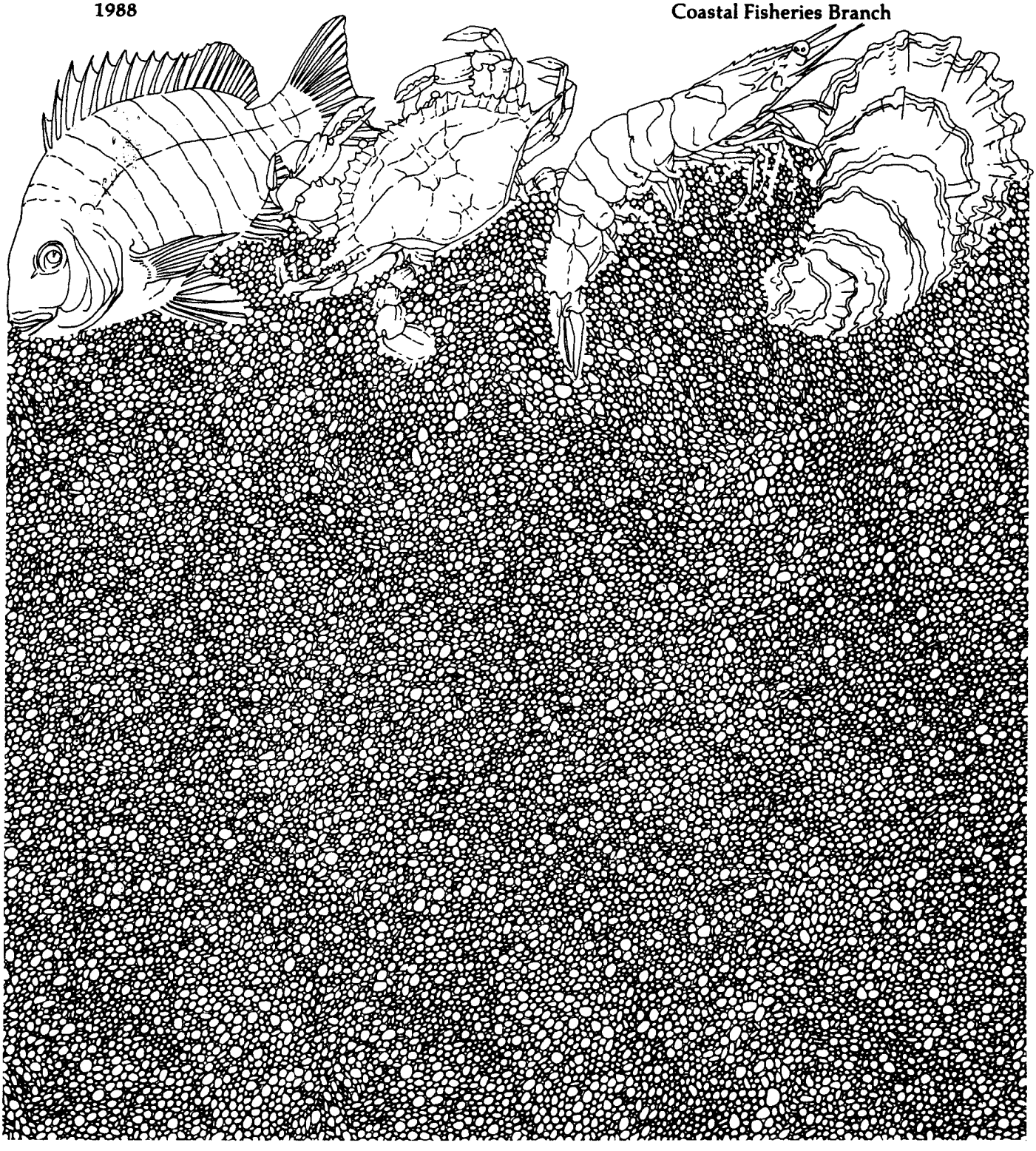
An Evaluation of Temperature And Photoperiod Induced Maturation of Snook

by Anne Henderson-Arzapalo, Robert L. Colura and Anthony F. Maciorowski

Management Data Series Number 143
1988

Texas Parks and Wildlife Department
Coastal Fisheries Branch



AN EVALUATION OF TEMPERATURE AND PHOTOPERIOD INDUCED MATURATION OF SNOOK

by

Anne Henderson-Arzapalo, Robert L. Colura
and Anthony F. Maciorowksi

MANAGEMENT DATA SERIES
No. 143
1988

Texas Parks and Wildlife Department
Coastal Fisheries Branch
4200 Smith School Road
Austin, Texas 78744

ACKNOWLEDGMENTS

This study was conducted with partial funding from the U. S. Department of Interior, Fish and Wildlife Service under DJ 15.605 (Project F-36-R).

We greatly appreciate the assistance of the Florida Department of Natural Resources Marine Research Laboratory in collecting snook.

ABSTRACT

Six female and three male subadult snook, Centropomus undecimalis, were collected in July 1984 from Tampa Bay, Florida and shipped by air to the Texas Parks and Wildlife Department, Perry R. Bass Marine Fisheries Research Station, Palacios, Texas. The fish were maintained in a 9500-l recirculating saltwater tank system with controlled temperature and photoperiod. Tank conditions were maintained at 26 C, 15 o/oo salinity, and 12-h light:12-h dark photoperiod for 1 year to maximize growth. From July to December 1985, tank conditions were changed to 30 C, 25 o/oo salinity, and a 15-h light:9-h dark photoperiod. On 5 September 1985, no males were flowing and three females exhibited primary oocytes in intraovarian tissue samples. One female exhibited a few stage II and III oocytes with primary oocytes predominating. Broodfish were subsequently subjected to a 3:1 compressed maturation cycle to induce maturation by May 1986. Monthly intraovarian samples collected from May to September 1986 indicated little gonadal maturation. No males yielded milt, and only one female showed limited ovarian development. Maturation and ova development did not progress and by September 1986 ovarian condition of the partially developed female also regressed.

INTRODUCTION

Reliable spawning methods are prerequisite to the development of large scale hatchery production techniques for any fish species. Declining populations of snook (Centropomis undecimalis) on the Gulf of Mexico coast has intensified interest in fingerling production for stocking programs (Daniel Roberts, Florida Department of Natural Resources, personal communication; Maciorowski et al. 1986). Previous spawning and fingerling production research utilized hormone induced ovulation and strip spawning in conjunction with laboratory culture of fry (Ager et al. 1976; Shafland and Koehl 1979). However, insufficient numbers of fingerlings were produced to support stocking programs. Initial saltwater pond culture trials indicated large scale production of snook fingerlings is possible, provided a reliable supply of fry is available (Maciorowski et al. 1986).

Temperature and photoperiod conditioning has been successfully used to induce gonadal maturation and spawning in several fishes (Arnold et al. 1976; Crim 1982; Henderson-Arzapalo and Colura 1987). The difficulty in obtaining adult snook in Texas necessitates controlled spawning of broodfish. The present study examines the effect of temperature and photoperiod conditioning on gonadal maturation of snook.

MATERIALS AND METHODS

Six female and 3 male subadult snook were captured by hook-and-line or beach seine from Tampa Bay, Florida, in July 1984. Fish were neither weighed nor measured at capture or during acclimation to reduce handling stress. The fish were air shipped to the Texas Parks and Wildlife Department, Perry R. Bass Marine Fisheries Research Station, Palacios, Texas.

Snook were placed in a 9500-l recirculating saltwater tank system equipped with a biofilter and ultraviolet sterilizer. Temperature was controlled with quartz immersion heaters and a 1.0 HP water chiller. A pin-set timer regulated photoperiod with a 100-W incandescent lamp serving as the light source. Water was exchanged as needed to maintain pH $\geq$7.0, unionized ammonia $\leq$0.8 mg/l, and salinity between 10-30 o/oo. Artificial sea salts (Fritz Chemical Co., Dallas, Texas) were added to adjust salinity as needed. Snook were offered 100-500 g of dead shrimp and chopped fish daily or on alternate days depending on feeding activity. Fish were observed daily for general appearance, disease symptoms and feeding activity.

Each snook was injected with 80 mg chloramphenicol (Parke-Davis Co., Morris Plains, New Jersey) and immunized against vibriosis with Biovax^{R} (Bio Med·Research Laboratories, Seattle, Washington) during transfer to the tank system. Within 2 months of capture, fish were prophylactically treated for parasites and bacterial infections with nitrofurazone, Trichlorfon^{R} (Argent Chemical Laboratories, Redmond, Washington), and potassium permanganate baths. Occasional infestations of the gills with monogenetic trematodes were treated with 0.25 mg/l Trichlorfon once weekly for 2 weeks.

Tank conditions over the study period are summarized in Table 1. The tank environment was initially maintained at approximately 26 C, 15 o/oo salinity, and a 12-h light:12-h dark photoperiod to maximize growth. Summer spawning conditions were simulated by raising the temperature to 30 C, salinity to 25 o/oo and photoperiod increased to 15-h light:9-h dark. On 16 December 1985, a 3:1 compressed maturation regime was initiated (Roberts et al. 1978) which exposed fish to summer spawning conditions in May 1986.

Fish were examined on 5 September 1985, 28 May, 2 July, 6 August and 9 September 1986 to determine the stage of gonadal development. The tank system was partially drained and the fish anesthetized with a commercial fish calmer (Hypno^{R}, Jungle Laboratories, Cibolo, Texas; Trance^{R}, Argent Chemical Laboratories, Redmond, Washington). Spermiation was determined by milt extrusion following abdominal massage. Ovarian tissue was sampled and staged as described by Hoff et al. (1972). Diameters of approximately 30 ova from each intraovarian sample were measured with an ocular micrometer and stereomicroscope and a mean (+ SD) ovum diameter calculated.

RESULTS AND DISCUSSION

No flowing male snook were found on any sampling date, although partial gonadal maturation of female snook occurred in 1985 and 1986. Spawning did not occur. Most ovarian tissue samples consisted of primary oocytes with mean ovum diameters $\leq$0.23 mm (Tables 2 and 3). One female exhibited partial ovarian maturation, consisting of primary oocytes with a few stage II-IV ova. The advanced ova constituted a very small portion of the total oocyte sample and did not increase during successive sampling. The partially developed female regressed by September 1986. One female could not be sampled at any time. The catheter would enter the oviduct but would not penetrate the ovary.

In spite of limited gonadal maturation, fish generally appeared healthy and fed normally. Occasional infestations of gill flukes were controlled with Trichlorfon with no apparent adverse effects to the fish. Broodfish should have been mature, measuring 615-735 mm TL on 5 September 1985 and increasing to 630-760 mm TL by 9 September 1986. Snook usually mature at age II or approximately 400-500 mm TL (Volpe 1959; Gilmore et al. 1983).

Temperature and photoperiod conditioning did not induce maturation in snook, however, it has been successfully used to maturate and spawn other marine and anadromous fish species (Hoff et al. 1972; Arnold et al. 1977; Henderson-Arzapalo and Colura 1987). As in the present study, snook subjected to annual and compressed cycles in Florida exhibited only partial gonadal maturation (Daniel Roberts, Florida Department of Natural Resources, personal communication). Reasons for incomplete maturation of snook through temperature and photoperiod conditioning are unknown. Contributing factors may be tank size, nutritional deficiencies and/or the absence of cyclical tidal and temperature variations which may stimulate maturation and spawning.

LITERATURE CITED

Ager, L. A., D. E. Hammond, and F. Ware. 1976. Artificial spawning of snook. Proceedings of the Southeastern Association of Fish and Wildlife Agencies 30:158-166.

Arnold, C. R., W. H. Bailey, T. D. Williams, A. Johnson, and J. L. Lasswell. 1977. Laboratory spawning and larval rearing of red drum and southern flounder. Proceedings of the Southeastern Association of Fish and Wildlife Agencies 31:437-440.

Arnold, C. R., J. L. Lasswell, W. H. Bailey, T. D. Williams, and W. A. Fable, Jr. 1976. Methods and techniques for spawning and rearing spotted seatrout in the laboratory. Proceedings of the Southeastern Association of Fish and Wildlife Agencies 30:167-178.

Crim, L. W. 1982. Environmental modulation of annual and daily rhythms associated with reproduction in teleost fishes. Canadian Journal of Fisheries and Aquatic Sciences 39:17-21.

Gilmore, R. G., C. J. Donohoe, and D. W. Cooke. 1983. Observations on the distribution and biology of east-central Florida populations of the common snook, Centropomis undecimalis (Bloch). Florida Scientist 46:313-336.

Henderson-Arzapalo, A. and R. L. Colura. 1987. Laboratory induced maturation and spawning of striped bass. Progressive Fish-Culturist 49:60-63.

Hoff, F., C. Rowell, and T. Pulver. 1972. Artificially induced spawning of Florida pompano under controlled conditions. Proceedings of the World Mariculture Society 3:53-69.

Maciorowski, A. F., A. Henderson-Arzapalo, D. E. Roberts, Jr., R. L. Colura, and C. E. McCarty. 1986. Fingerling production of snook in saltwater ponds. Proceedings of the 38 Annual Meeting of the Gulf and Carribean Fisheries Institute. In press.

Roberts, D. E., B. V. Harpster, and G. E. Henderson. 1978. Conditioning and induced spawning of the red drum (Sciaenops ocellata) under varied conditions of photoperiod and temperature. Proceedings of the World Mariculture Society 9:311-332.

Shafland, P. L. and D. H. Koehl. 1979. Laboratory rearing of common snook. Proceedings of the Southeastern Association of Fish and Wildlife Agencies 33:425-431.

Volpe, A. V. 1959. Aspects of the biology of the common snook, Centropomus undecimalis (Bloch) of Southwest Florida. Florida Board of Conservation and Technology Service #3.

Table 1. Recirculating tank system temperatures and photoperiods utilized from 27 July 1984 to 29 September 1986. Tank conditions were changed on the dates indicated. Salinity ranged 10-32 o/oo during the study.

Date	Temperature	Photoperiod h light:h dark
07/27/84	26	12:12
06/21/85	27	15:9
07/10/85	30	15:9
12/15/85	28	14.5:9.5
12/23/85	28	14:10
12/30/85	26	13.5:10.5
01/06/96	26	13:11
01/13/86	24	12.5:11.5
01/20/86	24	12:12
01/27/86	22	11.5:12.5
02/03/86	22	11:13
02/10/86	20	10.5:13.5
02/17/86	20	10:14
02/24/86	22	10.5:13.5
03/03/86	22	11:13
03/10/86	24	11.5:12.5
03/17/86	24	12:12
03/24/86	26	12.5:11.5
03/31/86	26	13:11
04/07/86	28	13.5:10.5
04/14/86	28	14:10
04/21/86	28	14.5:9.5
04/28/86	30	15:9
05/05/86	30	15:9
05/12/86	30	15:9
05/13 to 09/29/86	30	15:9

Table 2. Stage of gonadal development of snook females on 5 September 1985 (Hoff et al. 1972).

Fish total length (mm)	Stage of ovarian development
645	no sample
645	mostly primary oocytes, few stage II and III ova present
680	primary oocytes
690	primary oocytes
735	no sample
735	primary oocytes

Table 3. Mean ovum diameters of snook subjected to a 3:1 compressed maturation cycle (Roberts et al. 1978) from 16 December 1985 to 12 May 1986. Tank conditions were maintained at 30 C and 15-h light:9-h dark photoperiod from 12 May to 9 September 1986.

Sample date	Fish total length (mm)	Mean (± SD) ovum diameter (mm)
28 May	620	no sample
	650	0.19 ± 0.06
	660	no sample
	720	0.21 ± 0.04[a]
	750	no sample
	750	0.23 ± 0.03
02 Jul	620	no sample
	650	0.09 ± 0.02
	690	0.09 ± 0.02
	720	0.09 ± 0.02
		0.40 ± 0.05[a]
	740	tissue and fluid
	755	0.08 ± 0.02
06 Aug	630	no sample
	670	primary ova[b]
	695	primary ova[b]
	730	0.03 ± 0.01
		0.13 ± 0.03[a]
	745	tissue and fluid
	765	primary ova[b]
09 Sep	630	no sample
	650	0.07 ± 0.02
	670	no sample
	690	0.07 ± 0.02
	735	0.07 ± 0.02
	760	0.07 ± 0.02

[a]Sample contained mostly primary oocytes with a small percentage of more advanced Stage II through IV ova.
[b]Ova diameters not measured.

PWD-RP-3400-266A-7/88