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ATTEMPTED MATURATION OF SNOOK IN PONDS AND CAGES

by

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ABSTRACT

Snook (Centropomus undecimalis) were maintained in a 0.4-ha pond and in three cages in an 0.8-ha pond to induce maturation and spawning. The pond was stocked with 32 fish (13 males, 13 females and six unidentified) 25 May and 10 June 1988 and drained 31 October 1988. Snook were maintained in cages at a male to female ratio of 1:2 in two cages and 2:1 in the third cage from 10 June 1988 until 19 October 1988. Four to six fish from the pond were sampled monthly for evidence of gonadal maturation. Caged snook were sampled for evidence of gonadal maturation twice monthly. Ichthyoplankton samples were collected three times per week from the 0.4-ha pond to determine if spawning occurred. One spermiating male was found in the 0.4-ha pond, but no gravid females were found. No gonadal maturation was found in caged snook. No eggs or larval fish were found in ichthyoplankton samples.

INTRODUCTION

Snook (Centropomus undecimalis) are important esturine sport fish which are most common in the United States along the south Florida and south Texas coasts (Cooley 1974, Gilmore et al. 1983). Declining populations of the fish have resulted in harvest restrictions in both states and peaked interest in culture and stocking as a means of restoring populations (Maciorowski et al. In press). Spawning of snook, however, has met with limited success impeding the development of culture techniques for the fish. In Florida, wild fish have been spawned using hormone-induced strip-spawning techniques (Ager et al. 1976) but, in Texas, collection of broodfish eligible for strip-spawning has not been accomplished. Laboratory maturation and spawning of snook using photoperiod and temperature manipulation has been attempted and although limited success in inducing maturation has been reported (Plaia 1987, Henderson-Arzapalo et al. 1988) spawning has not been accomplished.

Pond and cage maturation and spawning is a commonly used fish culture technique (Piper et al. 1982, Marte et al. In press). Although successfully used to spawn many fishes, the method has not been evaluated as a procedure for spawning snook. The objective of the present study was to determine if pond held snook and snook held in cages within a pond will mature sufficiently to be eligible for strip-spawning.

MATERIALS AND METHODS

The pond maturation study was conducted from 25 May 1988 to 31 October 1988 and the cage maturation study from 10 June to 19 October 1988 at the Perry R. Bass Marine Fisheries Research Station, Palacios, Texas. Snook used for experimentation were collected by hook-and-line from the lower Laguna Madre and Brownsville Ship Channel during the summer and early autumn of 1987. The fish were held in indoor tanks at the Gulf Coast Conservation Association/Central Lower and Light Company/Texas Parks and Wildlife Department Marine Development Center near Corpus Christi, Texas, until study initiation.

The pond maturation study was conducted in a 0.4-ha pond filled 26 April 1988 and stocked with 22 snook on 25 May 1988 and 13 snook on 10 June 1988 (Table 1). Thirteen fish were identified as males and 13 as females. Sex of the remaining nine fish could not be determined. Mean ± SD total lengths (TL) of the fish at stocking were 591 ± 78 mm, 581 ± 109 mm and 516 ± 90 mm for males, females and unidentified fish, respectively.

The cage maturation study was conducted in four 1-m X 1-m X 1-m cages secured in an 0.8-ha pond. The pond had been filled 3 June 1988. Cages were constructed with 25-mm mesh plastic netting suspended from a buoyant frame constructed of 75-mm outside diameter polyvinyl chloride pipe. A 1-m X 1-m X 6-mm plywood cover was secured to the top of the cage (opening) to prevent escape of the fish. Two cages were stocked with two males and one female and two with one male and two females on 10 June 1988. Mean ± SD TL of the fish when placed in the cages were 568 ± 8 mm and 568 ± 20 mm for males and females, respectively (Table 1). During the first week of the study, a male

and female in one cage and a female in a separate cage died presumably due to initial handling. Remaining fish were combined on 17 June 1988 to provide a final study design of two cages with two females and one male and one cage with two males and one female.

A sample of four to six snook were collected monthly from the 0.4-ha pond and examined for gonadal maturation. All caged fish were examined twice monthly for gonadal maturation. Spermiation was determined by abdominal massage to extrude milt. Ovarian tissue was sampled by cathertization (Hoff et al. 1972) and examined microscopically to determine stage of development (Kuo et al. 1973). Additionally, 20 oocytes were measured with an ocular micrometer and a mean ovum diameter calculated.

To detect spawning in the 0.4-ha pond an ichthyoplankton sample was collected three times weekly by pulling a 20-cm diameter plankton net (250-μm mesh) horizontally 7 m at the pond surface. Each sample was immediately transported to the laboratory and examined for the presence of fish eggs and larvae with a Ward plankton counting wheel and stereomicroscope.

Snook in both the pond and cages were fed cut mullet (Mugil sp.), shad (Dorosoma cepedianum) and shrimp (Peneaus sp.) daily. Feeding rate was approximately 2% of the estimated body weight of the fish. Individual body weight was estimated from TL using Marshall's (1958) weight-length relationship for snook measured during each collection period.

Dissolved oxygen concentration (D.O.), temperature and salinity were determined once daily between sunrise and 0800 h at pond drains and at the pump intake. Dissolved oxygen concentration and temperature were determined by the membrane electrode method and a thermometer (YSI Model 58, Yellow Springs, OH). Salinity was measured with a salinity meter (YSI Model 33, Yellow Springs, OH). Rainfall was measured daily with an All Weather Rain Gauge (Lake Region Rehab. Ind. Inc., Fergus Falls, MN).

RESULTS AND DISCUSSION

Neither males nor females matured in cages. No gravid females were found among pond maintained snook although a single spermiating male was found on 5 October 1988 and at study termination. Size (580 mm TL) suggested it was the same male on both occasions. Eggs were successfully collected from a single caged fish (13 September 1988) and a single pond maintained fish (5 October 1988) but samples consisted of only primary oocytes. Mean ± SD ovum diameters were 0.06 mm ± 0.01 and 0.04 ± 0.01 mm for the cage and pond maintained fish, respectively. No snook eggs or larvae were collected during routine sampling of the pond in which the pond maturation study was conducted.

Reasons for failure of pond and cage held snook to mature or spawn may be:

1. Maintenance of snook in tanks until May and June provided insufficient time for the fish to mature in ponds.
2. Fish were too young and/or small to be sexually mature.

3. Nutrition was inadequate or inappropriate to induce maturation.
4. Environmental conditions in the pond prevented maturation.
5. Captivity may inhibit gonadal maturation of snook.

There are insufficient data to determine which is the most likely reason. Spawning of snook in Florida begins in May (Marshall 1958). Fish used in this study were retained in indoor tanks until May and June. While in the tanks the fish were subjected to photoperiod and temperature regimes simulating natural seasonal conditions at Brownsville, Texas (R. Vega, Texas Parks and Wildlife Department, personal communication). Under those conditions it would be expected that females would have had vitellogenic ova and males would have been spermiating when the study began. However, at study initiation, no gonadal maturation was observed. Gonadal recrudescence in Florida begins in late February (Marshall 1958) when temperatures are cooler and day lengths are shorter than those experienced in May. May photoperiod and temperatures would be expected to cause germinal vesicle migration, hydration and spawning. If gonadal recrudescence had not begun at study initiation exposure of the fish to May and/or June photoperiod and temperature conditions may have been inappropriate for inducing gonadal recrudescence.

Immaturity may explain why gonadal development did not occur in some snook. Marshall (1958) found approximately 50% of all snook in Florida 400-500 mm fork length (FL) were immature. He reported all females were mature when ≥ 500 mm FL and all males when ≥ 600 mm FL. Seven of the 13 known females and 12 of the 13 known males used for the pond maturation study were < 500 mm FL (Table 1). Of the six fish for which sex could not be determined only one individual (575 mm FL) was > 502 mm FL. Although these data suggest that a portion of the fish used in the study were subadult, it does not explain why gonadal maturation failed to occur in larger fish.

Nutritional requirements of snook are unknown but inadequate nutrition appears unlikely to have prevented gonadal maturation. At study termination both cage held and pond held fish had grown. Mean ± SD TL of the pond held males was 612 ± 73 mm and of females was 652 ± 96 mm, an increase of 21 and 71 mm for each sex, respectively (Table 2). Similarly, cage held male and female TL averaged ± SD 608 ± 47 and 578 ± 41 mm at study termination, an increase of 40 mm and 10 mm for each sex, respectively.

Sparse rainfall and high salinity of source water (Table 3) coupled with evaporation resulted in hypersaline pond conditions (Figure 1). Accompanying the high salinities was a single occurrence of D.O. < 3.0 mg/l in each pond (Figure 2). Salinities in the pond containing the cages were as great as 52 o/oo and a low D.O. of 2.7 mg/l was recorded. Fish in the pond culture maturation study experienced salinities to 55 o/oo and a low D.O. of 2.8 mg/l. Salinity and D.O. may have affected gonadal maturation of the snook, but it is unlikely. Hypersalinity is reported to have no effect on gonadal maturation of marine fishes (Harvey and Kelley 1984). A D.O. ≥ 3.0 mg/l is considered adequate for pond culture of fish and only continuous exposure to subleathal D.O. (1-3 mg/l) are reported to affect reproduction (Boyd, 1982). Mean monthly temperatures were the same in both experimental ponds and ranged from 23 to 29 C following seasonal trends (Figure 3).

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Table 1. Lengths and sexes of snook when stocked into ponds and cages at Perry R. Bass Marine Fisheries Research Station 25 May and 10 June 1988. A u under the column entitled sex indicates sex could not be determined.

	Total length (mm)	Fork length[a] (mm)	Sex
Pond			
	645	588	male
	785	710	male
	620	567	male
	620	567	male
	620	567	male
	610	558	male
	546	502	male
	615	562	male
	585	536	male
	500	463	male
	520	480	male
	510	471	male
	510	471	male
	750	679	female
	755	684	female
	480	445	female
	615	562	female
	640	584	female
	695	632	female
	660	601	female
	515	476	female
	530	489	female
	465	432	female
	480	445	female
	630	575	u
	520	480	u
	515	476	u
	595	545	u
	520	480	u
	545	502	u
Cages			
	560	515	male
	580	532	male
	570	523	male
	570	523	male
	560	515	male
	570	523	male
	590	541	female
	580	532	female
	580	532	female
	545	502	female

Table 1. (Cont'd)

Total length (mm)	Fork length[a] (mm)	Sex
540	497	female
570	523	female

[a] Fork length (FL) was calculated from total length (TL) using data collected for Table 2 to generate the regression equation: FL = 29.3670 + 0.8668 TL.

Table 2. Lengths and sexes at study termination of snook stocked into a pond and cages at Perry R. Bass Marine Fisheries Research Station 19 October and 31 October 1988. A u under the column entitled sex indicates sex could not be determined.

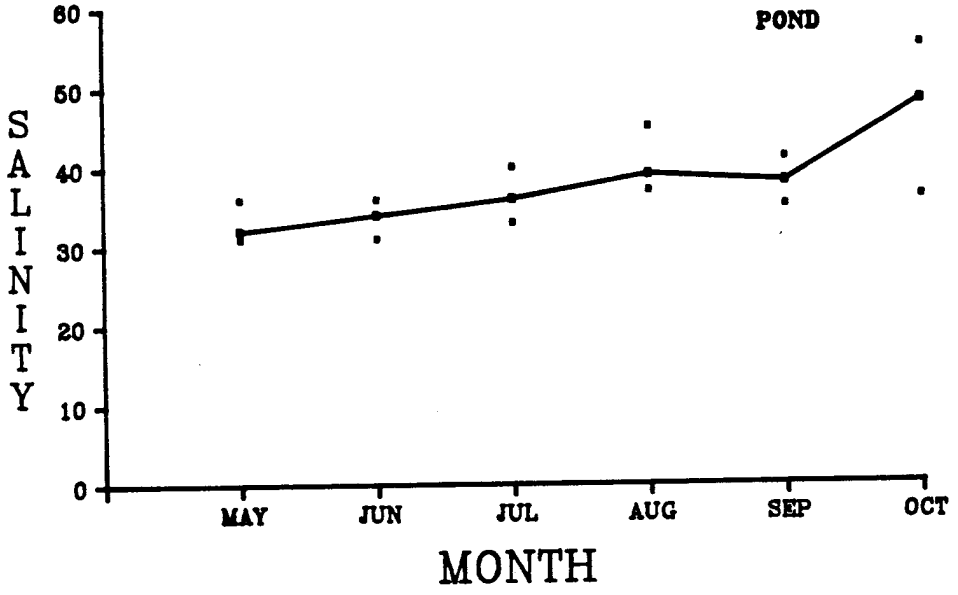
	Total length (mm)	Fork length (mm)	Sex
Pond			
	690	635	male
	803	650	male
	560	503	male
	655	600	male
	550	505	male
	660	605	male
	583	535	male
	540	495	male
	655	600	male
	610	560	male
	605	560	male
	535	485	male
	580	530	male
	675	625	male
	670	615	male
	650	595	male
	580	525	male
	575	520	male
	783	670	female
	475	435	female
	755	695	female
	745	710	female
	735	675	female
	560	515	female
	610	585	female
	585	535	female
	615	560	female
	705	645	female
	490	450	u
Cages			
	680	630	male
	575	530	male
	586	532	male
	662	607	male
	583	533	female
	594	540	female
	549	503	female
	--[a]	529	female
	635	595	female

[a] Caudal fin eroded

Table 3. Mean monthly rainfall, mean monthly salinity and salinity range of water at the pump intake of the Perry R. Bass Marine Fisheries Research Station May-October 1988.

Month	Rainfall (cm)	Salinity o/oo	
		Mean ± SD	Range
May	1.8	29 ± 1.1	27-31
June	2.6	30 ± 1.5	27-34
July	6.2	31 ± 2.6	27-43
August	1.4	31 ± 1.6	29-36
September	12.3	29 ± 2.0	25-33
October	2.8	37 ± 5.4	26-49

Figure 1. Mean monthly salinity (o/oo) in snook maturation pond and pond containing snook maturation cages, Perry R. Bass Marine Fisheries Research Station, 1988. Dots (.) represent maximum and minimum observed salinities.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MONTH

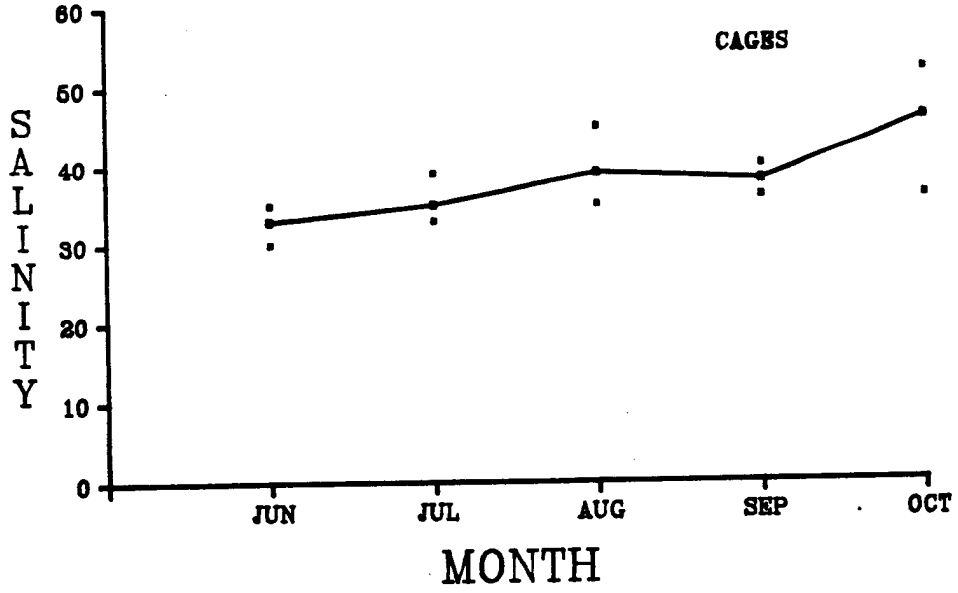
CAGES
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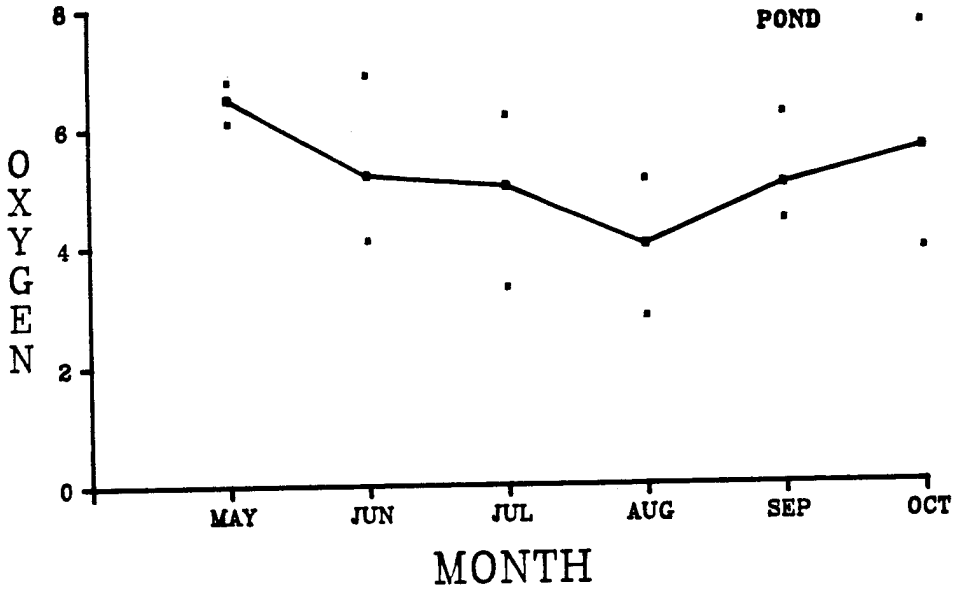
Figure 2. Mean monthly dissolved oxygen concentration (mg/l) in snook maturation pond and pond containing snook maturation cages, Perry R. Bass Marine Fisheries Research Station, 1988. Dots (.) represent maximum and minimum observed dissolved oxygen concentrations.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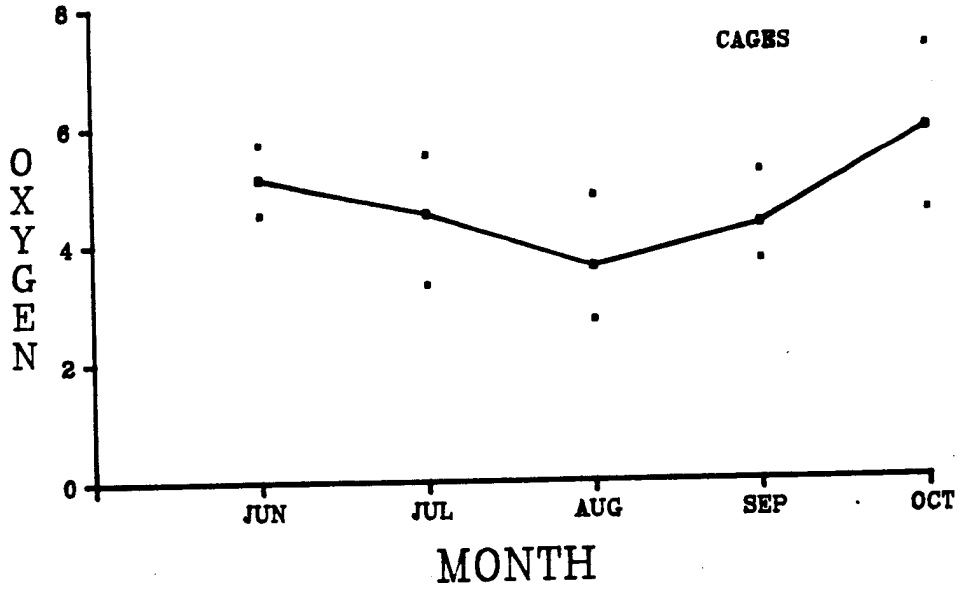
CAGES
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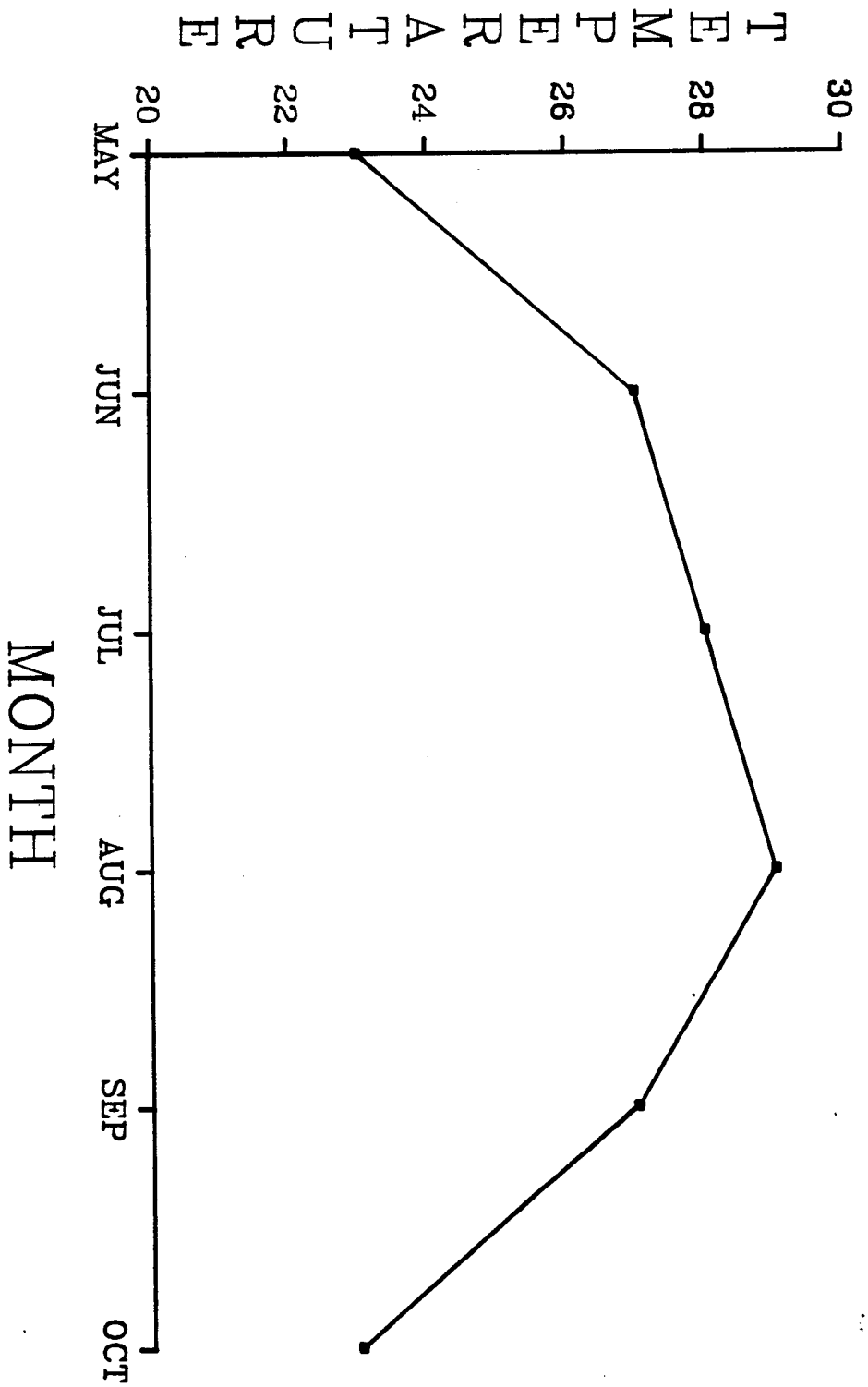
Figure 3. Mean monthly temperatures (C) in ponds used for pond and cage maturation of snook, Perry R. Bass Marine Fisheries Research Station, 1988.


TEMPERATURE
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