Fingerlings Production of Common Snook, *Centropomus undecimalis*, in Saltwater Ponds

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ABSTRACT

The common snook, *Centropomus undecimalis* provides an important sport fishery in the southern United States, Caribbean and Mexico. Declining populations, coupled with euryhaline tolerances and value of snook as a game fish have prompted interest in artificial propagation and stocking programs for fresh and saltwater. Because extensive fingerling culture is prerequisite to any stocking program, a study was undertaken to determine if snook fingerlings could be cultured in saltwater ponds. Fertilized eggs obtained from strip-spawned wild caught broodfish were transported from Florida to two Texas saltwater pond facilities via commercial air carrier. Eggs were incubated at 27-29°C and 31-38 °/oo salinity for 2.5 days yielding 616,000 fry for a 13.7% overall recovery. Fry were stocked into six fertilized earthen ponds and maintained for 29-37 days. Eighty-nine fingerlings were recovered for a 14% return. Fingerling size varied considerably between trials, ranging from 22-41 mm mean total length and 0.12-0.69 g mean weight. Following the initial nursery phase, 3,100 fingerlings were restocked into a 0.8 ha pond for advanced fingerling production. At 133 days of age, 1,665 fish averaging 103 mm TL were recovered (53.7% survival) yielding 0.11 kg/ha/day production. Results indicate snook fingerlings can be produced using saltwater pond culture techniques developed for other predaceous marine fishes.

INTRODUCTION

The common snook Centropomus undecimalis provides an important fishery in the southern United States, Caribbean and Mexico (La Monte, 1952; Volpe, 1959). Declining availability of snook in Florida and Texas has generated interest in artificial propagation and stocking programs to enhance natural recruitment (Shafland, 1976; McCarty, et al. in press). Although snook have been spawned and reared in the laboratory (Ager, et al. 1976; Shafland, et al. 1979), previous extensive culture trials are restricted to a limited stocking of 150 fry into freshwater ponds (Shafland and Koehl, 1979). Stocked ponds yielded a 30 percent return of fingerlings, but too few fish were recovered to properly evaluate snook as a candidate species for hatchery-scale fingerling production.

Although literature specific to snook culture is scant, recent studies indicate other highly predaceous marine fishes can be successfully cultured in saltwater ponds. Large scale production of red drum Sciaenops ocellatus fingerlings has become routine (Hysmith, et al. 1983; McCarthy, et al. in press), and is largely based on culture methods originally described for striped bass Morone saxatilis (Bonn, et al. 1976; Colura, et al. 1976; Geiger, 1983a,b). Such techniques have been successfully used to culture black drum Pogonias cromis (Colura and Hysmith, 1976), a black drum x red drum hybrid (Henderson-Arzapalo and Colura, 1984), and spotted seatrout Cynoscion nebulosus (Porter and Maciorowski, 1984). Accordingly, a study was undertaken to determine if snook fingerlings could be pond reared using similar techniques. The present investigation describes results of the first extensive culture of snook fingerlings in saltwater ponds.

METHODS AND MATERIALS

Collection

Gravid snook were collected from the mouth of the Manatee and Terra Ceia Rivers (Tampa Bay, Florida) 18 June, 18 July and 15 August, 1985. Fish were found in swash channels adjacent to mangrove islands during the ebb tide. A 61 m modified bag seine (0.5 cm stretch mesh) was deployed around a school by boat, the fish were encircled and forced into a 2 m bag. Fish were dip netted into a live well aboard a spotter boat and subsequently transferred to a 1000 l tank trailer for transport to the Florida Department of Natural Resources Marine Research Laboratory in St. Petersburg.

Spawning

Upon arrival at the laboratory, broodfish were anesthetized, examined, measured and biopsied following procedures of Roberts and Schlieder (1983). Fish were strip spawned by two methods: hormone induction; and forcing. The hormone induction method consisted of ovarian biopsy and abdominal massage, respectively,

to select functionally mature females exhibiting modal stage III oocytes (Roberts, et al. 1978) and flowing males. Selected females received a single intramuscular injection of 1000 IU/kg human chorionic gonadotropin (HCG) before dusk on the day of capture (18 June, 1985). Males were not injected. Fish were subsequently placed in a holding tank until 30 minutes post-ovulation, when they were strip spawned by the dry method (Davis, 1953).

The forcing method of strip spawning was used on fish captured in July and August, and involved selection of naturally ovulating females. Final gamete maturation of snook in Tampa Bay was found to occur rhythmically with lunar periodicity during the spawning season (Florida DNR, unpublished data). Accordingly, fish were captured in their spawning habitat near the midday high tide. At this time, final oocyte maturation was occurring naturally in females, and males were flowing hydrated sperm. Captured fish were returned to the laboratory, biopsied and massaged to verify gonadal condition, placed in holding tanks, and strip spawned 6 to 8 hours later.

Egg Incubation

Spawned eggs were incubated in 400 l fiberglass reinforced plastic conical tanks at 29°C and 34 °/oo salinity. Incubation medium was artificial seawater formulated from a dry synthetic sea salts mixture (Instant Ocean, Aquarium Systems, Inc., Mentor, Ohio). Eggs in three one liter aliquots were enumerated, averaged and the total number of eggs estimated by extrapolating the mean number of eggs per liter to the total incubation medium volume. Egg viability was estimated by determining the number of live and dead eggs in a random sample of 100 eggs at gastrulation.

The morning after spawning, fertilized eggs were packaged in polyethylene bags, sparged with oxygen, sealed in foam insulated containers, and shipped to either the Texas Parks and Wildlife Department (TPWD) Perry R. Bass Marine Fisheries Research Station (MFRS) at Palacios, or the TPWD-Gulf Coast Conservation Association John Wilson Marine Fish Hatchery (JWMFH) at Corpus Christi. Eggs were received the same day as shipped. Incubation procedures were similar at both facilities. Fertilized eggs were transferred to 1900 l cone bottom fiberglass tanks, and incubated at 27-29°C and 31-38 °/oo salinity. Incubation media consisted of sand-filtered Matagorda Bay water supplemented with a dry synthetic sea salts mixture (Fritz Chemical Co., Dallas, Texas) at the MFRS; and sand-filtered, ultraviolet-sterilized Laguna Madre water at the JWMFH. Alimentary development was complete approximately 2.5 days after spawning, at which time fry were concentrated, and fry numbers determined by volumetric estimation (Bayless, 1972). Fry were subsequently stocked into prepared saltwater culture ponds.

Fingerling Rearing Ponds, Fertilization and Sampling

Six pond culture trials were performed using 0.4 and 0.8 ha

rectangular earthen ponds, respectively, at the MFRS and the JWMFH. Respective saltwater sources for the two facilities were Matagorda Bay and the Laguna Madre. Ponds were filled with saran sock filtered (0.5 mm) water 9-29 days before the anticipated stocking date using the puddle technique of Bonn, et al. (1976). Pond fertilization consisted of combined organic and inorganic fertilizers for all trials, but specific fertilizers and fertilization rates differed (Table 1).

At the MFRS, 284 kg/ha cottonseed meal was initially applied to dry pond bottoms and liquid phosphoric acid and granular urea were added to partially filled ponds. Ponds were filled to a depth of 1.5 m, and remaining cottonseed meal was broadcast from pond levees in 32 kg/ha applications three times weekly to maintain plankton. Approximately two weeks after introducing fry, a commercial salmon starter (Silver Cup Feeds, Murray, Utah) was offered daily at an initial rate of 1.1 - 1.4 kg/day. Different fertilization and feeding rates between the May and August trials (Table 1) reflect different time intervals between initial filling and fry stocking, number of days in production, and different stocking rates.

At the JWMFH (Table 1), ponds were surface sprayed with 23.4 ℓ/ha liquid phosphoric acid and 28 ℓ/ha ammonium nitrate 1, 6, 12, 18 and 24 days after initial filling. Cottonseed meal was broadcast from pond levees and applied at an initial rate of 448 kg/ha at 6 days; following by applications of 56 kg/ha at 12, 18 and 24 days; and a final application of 28 kg/ha at 30 days after initial filling.

Zooplankton were sampled in each pond with a flexible impeller pump apparatus (Farquhar and Geiger, 1984). At the MFRS, each sample consisted of 25 ℓ of water from the pond drain box passed through a 64μ Wisconsin plankton net, and zooplankton were sampled three times per week. At the JWMFH, zooplankton were sampled once weekly by passing 20 L of water through an 80 plankton net. Samples were preserved in 5% buffered formalin. Organisms were identified by microscopy and enumerated using standard subsampling and counting techniques (Weber, 1973; APHA, et al. 1975).

Larval snook were sampled weekly during production using a 0.5 mm mesh dip net in each pond box. An additional 100 fingerlings were retained from each pond at harvest. Sampled fish were preserved in 5% buffered formalin and total length (TL) and weight determined for each specimen. Remaining fish from each pond were mass weighed with a dairy scale (Model 600, Hanson Co., Shubuta, MS) at harvest. Total number of fish recovered was determined by extrapolating mean individual weight of 100 fish (MFRS), or mean weight of five samples of 100 fish (JWMFH) from each pond to its respective total harvest biomass.

Advanced Fingerling Growth

Approximately 3,100 fingerlings resulting from pond trials 1 and 2 (Table 1) were transferred to a 0.8 ha pond at the MFRS on 25 July 1985 to allow additional growth (Trial 7) . The 0.8 ha pond was prepared 14 days before introducing fingerlings by

TABLE 1. SUMMARY OF FERTILIZER AND FEED APPLICATION RATES FOR SIX SNOOK FINGERLING POND CULTURE TRIALS AND ONE ADVANCED FINGERLING TRIAL (TRIAL NO. 7) AT THE PERRY R. BASS MARINE FISHERIES RESEARCH STATION (MFRS) AND THE JOHN WILSON MARINE FISH HATCHERY (JWMFH).

FACILITY	TRIAL NO.	INITIAL FILLING	CSM (KG/HA)	PHOSPHORIC ACID (L/HA)	UREA (KG/HA)	AMMONIUM NITRATE (L/HA)	FEED (KG/HA)
MFRS	1	23 MAY 85	828	3.75	1.7	-	46.8
	2	23 MAY 85	828	3.75	1.7	-	46.8
JWMFH	3	12 JUL 85	644	117	-	140	-
	4	12 JUL 85	644	117	-	140	-
MFRS	5	6 AUG 85	540	3.75	1.7	-	84.0
	6	6 AUG 85	540	3.75	1.7	-	84.0
	7	10 JUL 85	142	-	-	-	238.6

CSM = COTTONSEED MEAL

TABLE 2. STANDARD LENGTH (SL), WEIGHT, NUMBER OF VIABLE EGGS, AND NUMBER OF 2.5 DAY OLD FRY RECOVERED FROM STRIP SPAWNED SNOOK.

COLLECTION DATE	SPAWNING METHOD	FISH NO.	WEIGHT (KG)	SL (CM)	VIABLE EGGS (ALL FISH)	NO. FRY RECOVERED	POST INCUBATION SURVIVAL (%)
18 JUN 85	HORMONE	1	2.38	76.4	340,000	31,000	9.12
		2	3.55	60.8			
18 JUL 85	FORCING	3	7.02	81.0	3,420,000	394,300	11.53
		4	1.20	47.3			
15 AUG 85	FORCING	5	1.55	48.2			
		6	1.30	43.0			
		7	1.20	45.2			
		8	1.42	44.2	750,000	191,000	25.47

TABLE 3. SUMMARY OF SNOOK FINGERLING PRODUCTION DATA FROM SIX SALTWATER POND CULTURE TRIALS.

	TRIAL NUMBER					
	1	2	3	4	5	6
DATE STOCKED	21 JUN 85	21 JUN 85	21 JUL 85	21 JUL 85	17 AUG 85	17 AUG 85
NO. FRY STOCKED	15,500	15,500	220,300	174,000	95,500	95,500
NO. FRY/HA	38,750	38,750	275,375	217,500	238,750	238,750
DATE HARVESTED	24 JUL 85	24 JUL 85	19 AUG 85	19 AUG 85	25 SEP 85	25 SEP 85
NO. HARVESTED	5	3,880	36,560	42,980	4,880	530
% RECOVERY	0.03	25.10	16.57	24.66	5.08	0.56
KG HARVESTED	ND	1.36	4.54	5.27	3.36	0.30
MEAN TL (MM)	ND	33	22	22	41	38
MEAN SL (MM)	ND	26	18	18	32	30
MEAN WT (G)	ND	0.35	0.12	0.12	0.69	0.57
NO./KG	ND	2,857	8,043	8,147	1,447	1,766
KG/HA	ND	3.40	5.68	6.59	8.98	0.75
KG/HA/DAY	ND	0.10	0.20	0.22	0.23	0.02

ND = NOT DETERMINED

applying 142 kg/ha cottonseed meal on the dry pond bottom and filling to 2.1 m with unfiltered Matagorda Bay water. A #1 commercial salmon starter (Silver Cup Feeds, Murray, Utah) was offered at 2.84 kg/ha/day throughout the advanced fingerling production trial. Pellet size was increased as fish grew. Fish were seined bimonthly to determine average length and weight, and harvested at 133 days of age. Total number of fish recovered was determined by counting each individual as it was tagged with an abdominal streamer tag (Floy Tag and Manufacturing, Inc., Seattle, WA).

Water Quality

Water quality determinations were performed daily at each pond drain box between sunrise and 0830 h. Dissolved oxygen and temperature were determined by the membrane electrode and a thermometer, respectively (YSI Model 57, Yellow Springs, Ohio). Salinity was measured by a refractometer (AO Scientific Instruments, Buffalo, N.Y.) or salinity meter (YSI model 33, Yellow Springs, Ohio). Water in ponds was exchanged during the night when dissolved oxygen concentrations fell below 3.0 mg/ℓ.

RESULTS AND DISCUSSION

Spawning and Incubation

A total of 4.5 million viable fertilized eggs were obtained from 8 female snook on three separate spawning dates (Table 2). After air shipment and incubation through development of the alimentary tract and mouthparts, 616,000 fry (2.5 days old) were recovered for 13.7% post-incubation survival. Little comparable data regarding snook hatching success is available in the literature. Shafland and Koehl (1979) reported a 56% hatch from approximately 200,000 snook eggs, but did not specify larval age at the time of determination. Post-incubation survival of red drum fry at 36 hours ranges 55-71% under hatchery conditions (McCarty et al., in press), whereas 30% return at 48 hours is considered minimal for striped bass fry production (J.G. Geiger, TPWD, personal communication).

Fertilized snook eggs begin hatching 17-18 hours after fertilization (Shafland and Koehl, 1979), and hatching was evident in all shipping containers upon arrival in Texas. Accordingly, developing embryos and newly hatched fry may have suffered physical damage during air shipment and subsequent transfer to incubators. Hatching success of marine fish eggs decreases with crowding and low dissolved oxygen (Vetter et al., 1983). Depressed oxygen concentrations undoubtedly affected survival in about one half of the shipping containers as evidenced by decaying eggs and a foul odor upon arrival. Better hatching success and survival may have occurred had embryos been incubated through alimentary development at the spawning location.

Fingerling Production

Approximately 89,000 snook fingerlings were recovered from the 616,000 fry stocked into six saltwater culture ponds. Although fingerlings were recovered from all culture ponds, observed numerical yield, fingerling size and production values were variable (Table 3). Much of the production variability can be attributed to different saltwater sources and fertilization procedures (Table 1) between the two hatcheries.

The most striking water quality difference between the six culture trials (Table 4) is related to the different saltwater sources used by the MFRS, and the JWMFH. Average pond salinities (Trials 1,2,5,6) at the MFRS ranged 20-26 °/oo reflecting estuarine conditions of Matagorda Bay: in contrast, average salinity of the two trials conducted at the JWMFH (Trials 3,4) was 48 °/oo reflecting hypersaline conditions typical of the Laguna Madre. The different water sources provided the underlying basis for the different fertilizer types and application rates used at the two hatcheries (Table 1), and contribute to observed differences in zooplankton forage.

Mean weekly total zooplankton densities for the six culture trials (Figure 1, Table 5) demonstrate qualitative and quantitative differences in zooplankton distribution and abundance between the two facilities. Generally, total zooplankton densities (Figure 1) were an order of magnitude greater at the MFRS (Trials 1,2,5,6) and reflect greater abundance of rotifers and polychaete larvae. Rotifers are an important fish food for larval marine fishes (Houde, 1972), and differences in abundance may be salinity related. Minkoff, et al (1983) found high salinities increased hatching time and decreased hatching success in resting eggs of rotifers. Despite the importance of rotifers as first food, sustained larval growth is dependent upon ensuring an adequate zooplankton forage base throughout the pond culture period (Geiger, 1983a, b; Porter and Maciorowski, 1984). At both the MFRS and JWMFH, Acartia tonsa was the predominant crustacean zooplankter and presumably provided the majority of copepod nauplii and adults. Despite differences in rotifer and polychaete larvae densities between the two facilities, adult copepod and nauplii densities were similar.

Examination of snook production data (Table 3) in conjunction with pond water quality (Table 4) suggests that the poor numerical return and low biomass production in trials 1 and 6 were due to low dissolved oxygen. In both trials, dissolved oxygen concentrations near or less than 2 mg/ℓ occurred for three consecutive days. Shafland and Koehl (1979) indicated snook could tolerate short periods of oxygen depletion as low as 0.4 mg/ℓ, but their observations were for freshwater ponds.

Although the combined JWMFH trials (Trials 3, 4) provided the highest percent yield and number of fish (Table 3), average salinities of 48‰ adversely affected fingerling production. Nearly all snook fingerlings recovered from trials 3 and 4 died at harvest. Death was attributed to handling stress and hypersalinity. Although we found no literature regarding the

TABLE 4. MEAN (± S.D.) WATER QUALITY CHARACTERISTICS OF SALTWATER PONDS USED TO CULTURE SNOOK FINGERLINGS (TRIALS 1-6) AND ADVANCED FINGERLINGS (TRIAL 7).

WATER QUALITY CHARACTERISTIC	TRIAL 1 (N=36)	TRIAL 2 (N=36)	TRIAL 3 (N=58)	TRIAL 4 (N=38)	TRIAL 5 (N=42)	TRIAL 6 (N=42)	TRIAL 7 (N=73)
TEMPERATURE (°C)	27 ± 0.94 (25-29)	27 ± 3.4 (25-29)	29 ± 0.6 (27-30)	29 ± 0.6 (27-30)	28 ± 1.23 (25-30)	28 ± 1.25 (25-30)	26 ± 3.74 (17-30)
SALINITY (0/00)	20 ± 0.94 (19-22)	20 ± 0.99 (19-22)	48 ± 2.56 (44-51)	48 ± 2.64 (43-51)	25 ± 4.27 (23-28)	26 ± 1.26 (23-28)	23 ± 1.08 (21-25)
DISSOLVED OXYGEN (MG/L)	3.8 ± 1.10 (0.6 - 5.6)	4.6 ± 0.68 (3.2-5.9)	3.4 ± 0.47 (2.3-4.4)	3.2 ± 0.50 (2.2-4.4)	3.8 ± 0.87 (2.1-6.1)	3.5 ± 0.83 (1.6-4.8)	4.8 ± 0.77 (3.2-7.0)

NUMERALS IN PARENTHESES DENOTE RANGES

TABLE 5. MEAN (N=3) WEEKLY ZOOPLANKTON DENSITIES (ORGANISMS/L) IN EACH OF SIX SNOOK FINGERLING CULTURE TRIALS.

TRIAL 1

	ROTIFERS	COPEPOD NAUPLII	COPEPOD ADULTS	POLYCHAETE LARVAE	GASTROPOD LARVAE
WEEK 1	3742	165	93	189	-
WEEK 2	503	247	47	251	-
WEEK 3	20	194	7	209	-
WEEK 4	8	28	271	155	-
WEEK 5	1	141	30	341	-
WEEK 6	0	189	27	297	-
WEEK 7	79	262	72	115	-
(WEEK 8)	0	336	24	372	216

TRIAL 2

	ROTIFERS	COPEPOD NAUPLII	COPEPOD ADULTS	POLYCHAETE LARVAE	GASTROPOD LARVAE
	9286	330	193	193	-
	214	37	41	428	-
	7	108	33	160	-
	43	137	169	291	-
	159	109	12	477	11
	33	179	11	292	57
	4	162	25	104	62
	0	490	10	330	4140

TRIAL 3

	ROTIFERS	COPEPOD NAUPLII	COPEPOD ADULTS	POLYCHAETE LARVAE	GASTROPOD LARVAE
(WEEK 1)	0	15	10	0	-
(WEEK 2)	50	68	50	10	-
(WEEK 3)	1052	69	60	2	-
(WEEK 4)	942	65	21	0	-
(WEEK 5)	0	410	86	0	-
(WEEK 6)	0	118	194	5	-

TRIAL 4

	ROTIFERS	COPEPOD NAUPLII	COPEPOD ADULTS	POLYCHAETE LARVAE	GASTROPOD LARVAE
	0	0	5	0	-
	262	80	29	0	-
	690	440	98	0	-
	290	340	50	0	-
	575	370	275	5	-
	25	27	190	5	-
	0	98	400	0	-

TRIAL 5

	ROTIFERS	COPEPOD NAUPLII	COPEPOD ADULTS	POLYCHAETE LARVAE	GASTROPOD LARVAE
WEEK 1	3407	317	133	367	-
WEEK 2	243	12	16	331	-
WEEK 3	40	48	7	1341	1
WEEK 4	0	28	1	688	-
WEEK 5	104	51	1	343	-
(WEEK 6)	316	44	8	52	-

TRIAL 6

	ROTIFERS	COPEPOD NAUPLII	COPEPOD ADULTS	POLYCHAETE LARVAE	GASTROPOD LARVAE
	4773	223	120	267	-
	320	9	17	239	-
	125	58	8	1001	-
	0	41	28	522	1
	0	72	24	196	-
	44	92	12	92	-

WEEKS ENCLOSED IN PARENTHESES DENOTE ZOOPLANKTON DENSITIES BASED ON A SINGLE SAMPLE RATHER THAN A MEAN

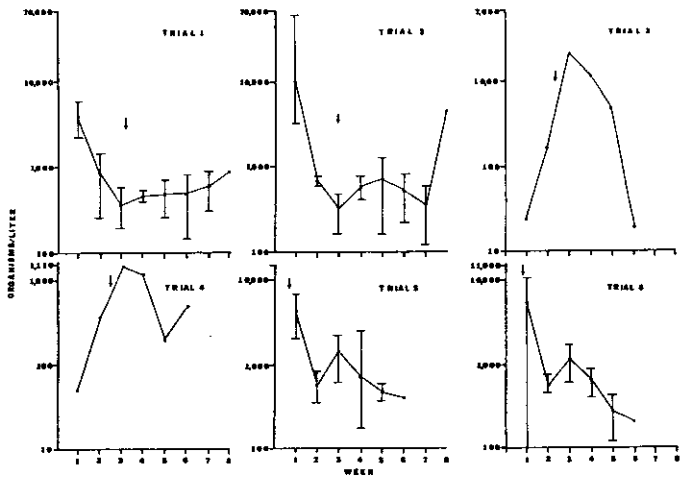

Figure 1. Mean (n=3) weekly total zooplankton densities (organisms/ℓ) for six snook fingerling culture trials. (Vertical bar denotes ± 1 S.D., points without a vertical bar represent a single sample, arrow denotes time of fry introduction).

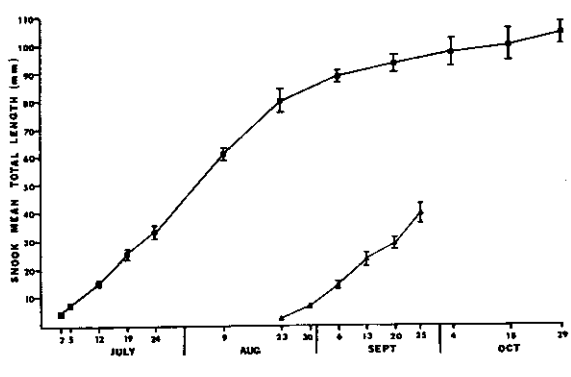

Figure 2. Snook mean total length (mm) during the 1985 production period. Squares (■) denote growth of the trial 1 and 2 fingerlings continuing through advanced fingerling production at MFRS. Triangles (▲) denote the growth of trial 5 and 6 fingerlings at the MFRS. Vertical bars denote ± 1 S.D.

effects of high salinities on snook growth or survival, red drum have been successfully cultured at salinities between 42-50 °/oo (McCarty et al., in press; TPWD unpublished data). At 50 °/oo and above, however, there is a marked reduction in fingerling yields. Additionally, snook fingerlings from trials 3 and 4 were harvested when mean TL and weights were 22 mm and 0.12 g, respectively. In red drum culture, smaller fish are more susceptible to the stress of harvest and transportation (McCarty et al., in press).

Additional sources of variation for the pond culture trials included fry stocking rates and the number of days in production. In the present study fry stocking rates were determined solely on the basis of availability. Accordingly, trials 1 and 2 were conducted at an unusually low stocking rate of 38,750 fry/ha. Remaining trials were also performed with low stocking rates, but were more or less comparable at 217,500 to 275,000 fry/ha (Table 3). In contrast, the typical stocking rates for routine production at the MFRS and JWMFH range was from 375,000 to 1,225,000 fry/ha. Despite the large variation in fingerling size between pond trials (0.20 to 0.69 g and 22 to 41 mm TL), biomass production was similar for ponds unaffected by low dissolved oxygen (Trials 2-5) and ranged from 0.10 to 0.23 kg/ha.

Advanced Fingerling Production

Approximately 54% (1,665) of the 30 day old fingerlings survived the 133 day growth period to the advanced fingerling stage. Mean (± S.D.) standard length, total length and weight were 82.01 ± 3.38 mm, 103.05 ± 3.86 mm, and 7.10 ± 0.80 g, respectively (n=100). Total biomass harvested was 8.08 kg, yielding 0.11 kg/ha/day overall production. Snook appeared to grow more slowly (Figure 2) than other marine species under extensive pond culture conditions. Red drum stocked at 5,000 fish/ha and fed commercial feeds yielded production of 3.35 kg/ha/day (Hysmith, et al. 1982). Previous advanced fingerling studies conducted at the MFRS with spotted seatrout and a hybrid spotted seatrout x orangemouth corvina (Cynoscion xanthulus) yielded final production estimates of 0.30 and 0.75 kg/ha/day, respectively (TPWD unpublished data). Like spotted seatrout and the spotted seatrout x orangemouth corvina hybrid, snook do not appear to ingest prepared feed. In contrast, red drum readily accept commercial feeds and are, therefore, more amenable to extensive pond culture beyond the initial nursery pond phase.

CONCLUSIONS

The present investigation conclusively demonstrates snook can be reared in saltwater ponds on a hatchery scale. Although overall the fingerling return of 14% for the six culture trials was low, the yield was reasonable when compared to first pond culture trials of other marine fishes. Initial attempts to culture red drum and spotted seatrout yielded fingerling returns averaging 20% and less than 3%, respectively (Colura et al.,

1976). Improved pond management strategies developed for striped bass (Braschler, 1974; Geiger, 1983a, b) have subsequently been used with the former two species improving average fingerling yields to 40% for red drum in routine hatchery production (McCarty, et al. in press), and 37% for spotted seatrout in experimental hatchery trials (Porter and Maciorowski, 1984; TPWD unpublished data). Accordingly, it is anticipated that these same techniques can be successfully modified to accommodate snook fingerling production.

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