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EFFECTS OF FEEDING REGIMES AND SOURCES OF FISH ON PRODUCTION OF ADVANCE FINGERLING STRIPED BASS

by
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ABSTRACT

Research on the production of advanced fingerling striped bass, *Morone saxatilis* (Walbaum), was conducted in ponds at Auburn University Fisheries Research Unit in the summer and winter of 1971. Investigations were conducted to determine the effects of two feeding regimes and two sources of small fingerlings on the survival and production of advanced fingerling striped bass.

Fingerling striped bass from the Cooper River, South Carolina, and the Savannah River, Georgia, were studied. Higher survival and greater production were obtained from the Cooper River fish. One feeding regime fed hourly, 15 hours per day; the other fed at 3-hour intervals, 15 hours per day. The two feeding regimes were not significantly different.

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INTRODUCTION

The use of advanced fingerling striped bass, *Morone saxatilis*(Walbaum), (15 to 20 cm.) is believed, by many researchers, to be advantageous in certain stocking programs. This method is thought to be especially applicable in riverine stocking programs where advanced fingerlings potentially have higher survival than smaller fingerlings (3 to 8 cm.); also, marking fish for migration studies is more easily accomplished.

At present, rearing of advanced fingerling striped bass is hampered by poor survival and high feed conversions in production ponds. Reluctance of small fingerlings to adapt to artificial diets has contributed to low survival and high feed conversions. *Chondrococcus columnaris* infections have been the cause of the initial mortality in many cases and epizootics of this disease have also increased mortalities during the growing season (Kelley, 1969; Ray and Wirtanen, 1970).

At the Edenton National Fish Hatchery, Edenton, North Carolina, researchers have investigated the effects of frequency of feeding, amount of feed, and sources of fish on conversion and survival. Initiating feeding in holding tanks and utilizing artificial diets in ponds have also been evaluated. Survival of advanced fingerlings ranged from 5.8 to 87.7 per cent with feed conversion values from 1.4 to 32.2.

Research on production of advanced fingerlings has been conducted at the Fisheries Research Unit at Auburn University for five years. Investigations have covered the utilization of forage species as food, feeding and stocking rates, and frequency of feeding. Conversions during this period have ranged from 14.0 to 21.4. Survival has ranged from 0 to 81 per cent.

The objectives of this research were to determine the effects of two feeding regimes and two sources of small fingerlings on the production of advanced fingerling striped bass. Special emphasis was placed on increasing survival and lowering conversion rates in extensive culture.

MATERIALS AND METHODS

Experimental Ponds

Twelve 0.04-ha. (0.1acre) earthen ponds located at the Fisheries Research Unit of the Auburn University Agricultural Experiment Station were chosen for this research. These adjoining ponds ("E" series) have concrete rip-rap around the edges. They are 1.5 to 2.0 m. deep at the standpipe and have an average depth of 1 m. Water is supplied by a small creek and enters the ponds through saran filters (39 mesh per cm.). Each pond was equipped with one Neilsen automatic fish feeder. There were four master units and eight slave units. Each master unit controlled two slave units. The slave units could be set for quantity of food fed each feeding and the master units could be set for number of daily feedings, length of the feeding period (seconds), and quantity of food fed at each feeding. By taking advantage of this flexibility, each feeder could be set for the individual requirements of each pond within a feeding regime.

All ponds were drained and refilled from May 27, 1971, to June 19, 1971. Draining dates were affected by lack of available space for small fingerling stripped bass present in the ponds used in this experiment. Ponds were refilled immediately and disinfected with 11.25 kg/ha. potassium permanganate. Disinfection was accomplished 4 to 15 days prior to stocking the striped bass fingerlings.

Two methods were employed in an attempt to control the growth of filamentous algae: (1) white amur were stocked at 74 and 100 fish (41 to 53 cm. TL) per hectare (64.3 to 113.3 kg/ha.); (2) ponds were treated, as necessary, with Diquat or Paraquat at 0.50 to 1.00 ppm.

A mixture of 12 l. of diesel fuel and 1 l. of motor oil (SAE 30) was applied to each filled pond to control insects that might prey upon the smaller striped bass.

Water Quality

Dissolved oxygen and pH levels were recorded at least weekly and usually every three days. Dissolved oxygen was measured with a YSI oxygen meter (Model 51). When undesirable oxygen levels were approached, checks were made daily. Samples for pH determinations were taken to the laboratory and checked on a Photovolt Electronic pH Meter (Model 125).

Experimental Fish

Small fingerling striped bass (3 to 8 cm.) were obtained from an earlier fry rearing experiment (Reeves and Germann, 1972). Production ponds were stocked as the rearing ponds containing small fingerling striped bass were drained. The fish were carried from rearing pond to production pond in a 1 percent salt solution to which 20 ppm acriflavin had been added to inhibit bacterial infections. This concentration of acriflavin is below the minimum toxicity level for striped bass suggested by Highes (1969). The fish were then tempered to the pond water and released. Production ponds were stocked with 32,500 small fingerlings per hectare from one or more rearing ponds. Stocking took place from May 27 to June 26, 1971. Lack of manpower and pond availability were responsible for the long stocking period. After each production pond was stocked, feeding at 1 per cent body weight per day was begun to maintain fish until the experiment was begun.

Treatments

Treatments involved in this experiment were source of fingerlings and feeding regimes. Striped bass fingerlings were obtained from an earlier fry rearing experiment and were originally obtained as larvae from the Cooper River, South Carolina (Moncks Corner Hatchery), and the Savannah River, Georgia (Richmond Hill Hatchery).

Two feeding regimes were tested, both of which fed over a period of 15 hours per day. One fed every hour 15 hours per day (15 feeds/day); the other fed at 3-hour intervals 15 hours per day (5 feedings/day). On June 30, 1971, the feeders were set to feed amounts calculated from weight estimates of the fish stocked in each pond. The fish were fed seven days a week at 10 per cent of body weight per day. This high rate of feeding was considered necessary initially because of the small amount of feed distributed at each feeding. The maximum daily amount of feed that could be fed was considered to be 49.8 kg./ha. When the 10 per cent feeding rate reached this amount, no furhter increases were made. Fish in all ponds were fed individual amounts determined by 3-week periodic samples.

Equal parts of Purine Trout Chow No. 2 and No. 3 were fed at first. This mixture was followed in sequence by Purina Trout Chow No. 4, Large Fingerling and Size Developer.

The data were analyzed by analysis of variance for a 2 x 2 factorial design.

Growth and Harvesting

Data for growth determinations were collected in-seine samples at 3-week intervals during the experiment and from measurements of all fish taken after draining. Measurements recorded were total length in mm. and weight in g. Total length was measured on a standard meter board and weight was measured on dietetic scales.

All ponds were drained from December 10, 1971, to January 13, 1972. High water temperatures during the draining period greatly influenced the draining dates. The volume of ponds was reduced by one-half the night prior to harvesting and the fish were removed early the next morning. Fish were collected with a 50-foot, 3/8-inch mesh seine and placed immediately in a 1 per cent salt solution.

RESULTS AND DISCUSSION

A total of 15,000 striped bass fingerlings (2.5 to 7.6 cm.) weighing 35.77 kg. was stocked into twelve 0.04-ha. earthen ponds. A total of 9,157 fingerlings (7.0 to 27.0 cm.) weighing 487.55 kg was recovered. Mean survival for all ponds was 57.3 per cent. The number of days in the experiment varied from 163 to 197. A summary of recovery data is presented in Table 1.

Higher survival and greater production was obtained from the Cooper River fish. Feeding regimes of three feedings during a 15-hour period differed very little from hourly feeding during a 15-hour period.

Mean survivals for the Cooper River and Savannah River strains were 72.0 and 42.6 per cent, respectively. Statistical analysis of the data on survival between sources revealed a significant difference at the 0.05 probability level. The difference in survival between feeding regimes was not significant (0.05 probability level). There was no significant difference between survival in feeding regimes within a source for either of the two sources. Survival of sources within the 15/1 feeding regime were not significant. However, within the 15/3 feeding regime, survivals of the two sources were significantly different at the 0.05 probability level (Table 2).

Total production of the Cooper River fish was 396.33 kg with 91.22 kg for the Savannah River fish, a significant difference at the 0.01 probability level. The slight differences between feeding regimes were not significant (0.05 probability level). Productions between sources within the same feeding regime were significantly different at the 0.01 probability level for both feeding regimes (Table 3). Productions between feeding regimes within a source were not significant for either source (0.05 probability level).

The effect of survival confounds the production data. Ponds that had high production had high survival and high average weights (Table 4). A factor that may have affected production was the method of stocking fish from rearing ponds to production ponds. Ponds E-13, E-25, and E-26 were all stocked with fish reared in E-4 which were feeding well on supplemental feed and had an average size of about twice that of any other pond. However, this factor was discounted from having any great effect on the final analysis since other ponds (E-28 and E-29) stocked with much smaller fish had similar productions (Table 4).

A comparison of ponds with approximately 160 days and similar ponds with 197 days in the experiment shows that the difference in numbers of days in the experiment had little or no effect. Since there was little difference in production between the two time intervals, it might be inferred that production of advanced fingerling striped bass over 160 days is not desirable. Also, since feeding would be shortened by approximately 30 days, conversions might be lowered.

The most influential factors affecting survival and production in this experiment were parasites and diseases. Bacterial infections of *Ameromonas sp.* and *C. columnaris* were problems throughout the experiment, especially after samples were taken, however, epizootics occurred within sampling periods. Protozoan parasites *(Trichodina, Glossatella,* and *Scyphidia)* were occasional problems. They caused mortalities in a few instances and probably led to secondary bacterial infections.

Individual pond treatments of 3 ppm $KMnO4$ and 10 ppm formalin were effective in reducing protozoan related mortalities. Bacterial infections were treated with tetracycline hydrochloride fed at 1 g. antibiotic activity per pound of feed for 10 days. This treatment reduced or stopped mortalities, but when un-

Table 1. Results at draining for twelve 0.04-Hectare production ponds stocked with striped bass fingerlings.

Pond Number	Source	Feeding Regime	Stocking Rate (No./Hectare)	Fingerlings Recovered/Hectare	Per Cent Survival	Days in Experiment
E-13	Cooper River	15/3[1]	32,500	27,575	84.8	197
E-25	Cooper River	15/3	32,500	21,950	67.5	169
E-26	Cooper River	15/3	32,500	22,750	70.0	196
E-16	Cooper River	15/1[2]	32,500	19,750	60.8	196
E-28	Cooper River	15/1	32,500	21,125	65.0	169
E-29	Cooper River	15/1	32,500	27,225	83.8	190
E-14	Savannah River	15/3	32,500	16,900	52.0	197
E-15	Savannah River	15/3	32,500	11,000	33.9	197
E-27	Savannah River	15/3	32,500	7,025	21.6	196
E-17	Savannah River	15/1	32,500	9,500	29.2	190
E-18	Savannah River	15/1	32,500	23,000	70.8	163
E-30	Savannah River	15/1	32,500	15,575	47.9	163

[1] 1 feeding every 3 hours for a 15-hour period.
[2] 1 feeding every hour for a 15-hour period.

Table 2. Survival of striped bass fingerlings from two sources in two feeding regimes in twelve -.04-hectare (0.1-acre) production ponds.

Source of Fingerlings	Feeding Regime 15/3	15/1	Mean
Savannah River	1659[1]	1923	430
Cooper River	2803	2772	929
Mean	744	783	

[1]Sum of fish from 3 replications (ponds).

Table 3. Production of striped bass fingerlings from two sources in two feeding regimes from twelve 0.04-hectare production ponds.

Source of Fingerlings	Feeding Regime 15/3	15/1	Mean
Savannah River	30.9[1]	60.2	15.2
Cooper River	205.9	190.3	66.1
Mean	39.48	41.75	

[1]Sum of 3 replications (ponds) in kg.

treated food was substituted after the 10th day, a rise in daily mortalities was usually noticed. All treatment levels were within ranges suggested by Hughs (1969 and 1970) and Welborn (1969).

Observed mortality related to parasites and diseases from all ponds was 784 fish (5%); however, the total mortality during the experimental period was 6,665 fish (43%). Counting dead fish during the experimental period was considered a poor technique to obtain an estimate of parasite and disease mortality.

Sampling data collected at 3-week intervals provided erroneous and highly variable results because only one seine haul was made in each sample. In several cases, consecutive samples indicated little or no weight gain or even losses in weight. Only one sample was used to prevent undue excitement, stress, and injury to the fish. Approximately 50 fish were randomly chosen from each seine haul and weighed. They were counted as they were returned to the pond. Sampling was discontinued after September 7 because of disease problems incurred as a result of the sampling procedure. After this date, feeders were adjusted "by sight" as whether or not feed was accumulating in the pond. By this method, feeders were adjusted every 3-5 days and feeding rates could be estimated. Table 4 presents growth data obtained at the completion of the experiment.

Correct adjustment of the feeders was a constant problem. Variation resulted from two areas: size of the food particle and size of the gate opening when the gate was in the "up" position.

Water quality parameters remained within acceptable limits throughout the experiment in all ponds except E-25. An oxygen depletion occurred in this pond on September 18, two days after a 10 ppm formaldehyde treatment was applied. The lowest oxygen level recorded was 2.5 ppm; and at this concentration, the fish were at the surface apparently in stress. The problem was corrected by flushing fresh water through the pond.

Table 4. Growth of striped bass fingerlings fed Purina Trout Chow in twelve 0.04-hectare production ponds.

Pond Number	Source of Fingerlings	Feeding Regime	Stocking Weight (kg)	Recovery Weight (kg)	Average Weight (g)	Ration Fed (kg)	S Conversion	Range Length (TL) (mm)
E-13	Cooper River	15/3	5.99	79.95	72.48	110.17	1.49	70-250
E-25		15/3	5.99	65.19	71.64	131.30	2.22	80-260
E-26		15/3	5.99	60.93	77.12	112.93	2.05	90-260
E-16		15/1	1.48	56.07	63.86	118.68	2.17	90-250
E-28		15/1	1.61	64.54	80.18	102.21	1.62	110-250
E-29		15/1	1.30	69.65	63.96	115.00	1.68	90-250
E-14	Savannah River	15/3	0.81	8.51	12.58	95.45	12.39	80-260
E-15		15/3	1.78	4.87	11.06	87.44	28.29	60-270
E-27		15/3	0.86	17.58	62.57	86.53	5.17	70-250
E-17		15/1	0.92	7.99	21.03	86.40	12.20	80-240
E-18		15/1	1.07	41.14	44.71	111.95	2.79	60-270
E-30		15/1	0.67	11.13	17.87	64.37	6.15	50-250

Table 5. A comparison of water temperatures and mortality of striped bass fingerlings at draining.

Date	Temperature (°C)	Ponds Drained	Mortality (No. Fish)	Percentage Mortality
January 6, 1972	9.0	E-17, 29	16	1.2
January 12, 1972	10.0	E-25, 26, 27	67	3.4
January 13, 1972	13.0	E-13, 14, 15	240	10.8
December 10, 1971	14.5	E-18, 30	296	19.2
December 16, 1971	19.0	E-16, 28	743	43.1

The rates at which white amur were stocked were ineffective in controlling filamentous algae. On several occasions, they were observed feeding on the pelleted food along with the striped bass.

Fish from all ponds were handled similarly during draining; however, the mortality encountered during draining varied greatly. Mortality was apparently related to the various water temperatures at which the fish were removed. The data presented in Table 5 suggests that a significant mortality might be expected if draining occurs at temperatures above 10 C.

CONCLUSION

1. A total of 15,600 striped bass fingerlings was stocked into twelve 0.04-ha. earthen ponds and 9,157 advanced fingerlings were recovered upon draining. Mean survival for all ponds was 57.3 per cent.
2. The differences in survival and production between the two feeding regimes were not significant.
3. Production and survival of the Cooper River fish was higher and significantly different from that of the Savannah River fish.
4. Parasites and diseases advursely affected overall survival and production in this research.
5. Mortality experienced at draining was directly related to the water temperature of the ponds during draining.

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THE MATCHED PAIR — NATIONAL ENVIRONMENTAL POLICY ACT AND THE FISH AND WILDLIFE COORDINATION ACT

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ABSTRACT

Short description of both pieces of legislation highlighting the similarities and differences; the strengths and limitations of each. Based on recent National Marine Fisheries Service's experience concludes that both can be used in a mutually supportive manner to benefit fish and wildlife resources.

INTRODUCTION

Long before the general public awakened to environmental issues, biologists and administrators responsible for fish and wildlife were painfully aware of the impact of man's developmental activities on the resource under their purview. From mammoth Federal projects to private dredge-and-fills on fractions of acres, the cumulative damage has totalled thousands of acres of habitat annually. (Anon.1967). This professional awareness was accompanied by a sense of frustration and impotence, as the environmental-altering developments seemed to move with a dynamism of their own.

Through most of this period there was one channel, however imperfect, for investigating, modifying and, in some cases, opposing this seemingly inexorable developmental thrust. This was the Fish and Wildlife Coordination Act[1] (hereinafter referred to as the Coordination Act). The Act states that "wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs..." It applies to virtually all types of water-resource projects undertaken either directly by a Federal agency or under a Federal permit or license. It requires these agencies to provide for planning participation by the Fish and Wildlife Service and the State fish and game departments and to respond specifically to their reports and recommendations for mitigation and enhancement of fish and wildlife resources (McBroom 1958).

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[1]16 U.S.C. 661 et seq.

[2]42 U.S.C. 4321 et seq.