THE EFFECT OF INCREASED SODIUM CHLORIDE ON STRIPED BASS FRY SURVIVAL IN FRESHWATER PONDS

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ABSTRACT

An investigation of the effects of increased sodium chloride concentrations on striped bass fry survival was conducted at the Auburn University Fisheries Research Unit from April 8 to July 7, 1972. The mean survival of fry in ponds with increased sodium chloride concentrations was 7.65% as opposed to 1.70% in six control ponds. The survival in all ponds was highly variable, ranging from 0.33 to 39.50% in increased sodium chloride ponds and from 0.00 to 9.58% in control ponds.

INTRODUCTION

The development of spawning methods by fishery workers in South Carolina to obtain large numbers of striped bass, *Morone saxatilis* (Walbaum), fry (Stevens, 1967) created interest in other states to establish this species as a sport fish and as a biological control for gizzard shad, *Dorosoma cepedianum* (LeSueur), in freshwater lakes throughout the United States. As a result, much additional research has been conducted to develop techniques that could be used to successfully culture striped bass fry and fingerlings for use in stocking programs. Presently striped bass culturists are plagued with the unpredictability of fry survival in earthen ponds. Fry survival rates have fluctuated greatly and the number of surviving fingerlings cannot be accurately estimated until ponds are drained.

Researchers have provided little evidence to demonstrate that any one factor would increase the survival of striped bass fry. But Albrecht (1964) and Germann (1972) reported higher survivals of striped bass fry in waters of low salinity (chloride of 920-948 ppm and a salinity of 1,300 ppm ± 200 ppm, respectively). Lewis (1972) reported that the production of channel catfish, *Ictalurus punctatus* (Rafinesque), was increased in ponds where the water had 0.17% sodium chloride concentration.

Since striped bass are anadromous fish and because sodium and chloride are the main ions in sea water, the objective of this research was to determine if pond water with increased sodium chloride concentrations would increase survival of striped bass fry.

MATERIALS AND METHODS

Experimental Ponds

Twelve 0.04-ha (0.10-acre) earthen ponds located at the Fisheries Research Unit of the Auburn University Agricultural Experiment Station were selected for this research. These adjoining ponds had concrete rip-rap edges and were 1.5 to 2 meters deep at the standpipe with an average depth of 1 meter. A small creek served as the water supply for these ponds.

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Preparation of Experimental Ponds for Stocking

All ponds were drained March 14, 1972 and allowed to dry for 7 days before refilling. During this drying period the pond bottoms were raked to remove filamentous algae.

Control of filamentous algae was attempted by fertilization and by the use of Diquat. The ponds were treated with Diquat at 1 ppm as recommended by Lawrence (1968). A concentration of 1 ppm was the 96-hour LC50 of striped bass fry as reported by Hughes (1969). A concentration of 1 ppm was well below the 96-hour LC50 of striped bass fry reported by Regan, Wellborn and Bowker (1968).

After the ponds were refilled, coastal Bermuda hay at a rate of 460 kg/ha and meat and bone meal at a rate of 112 kg/ha were added to stimulate production of zooplankton. Additional meat and bone meal at a weekly rate of 56 kg/ha and Auburn No. 3 fish feed at a weekly rate of 34 kg/ha were applied as deemed necessary to maintain similar zooplankton populations in all ponds. Triple superphosphate fertilizer at a weekly rate of 19 kg/ha and ammonium nitrate fertilizer at a weekly rate of 22 kg/ha were applied as deemed necessary to maintain a water surface visibility of 30 to 37 cm in all ponds.

Zooplankton abundance was determined with the use of a 1.3 meter zooplankton net (60 mesh per cm) with a 0.3 by 0.7 meter rectangular opening. Samples were transferred to glass jars, preserved with 10% formalin, and then allowed to settle 24 hours after which the depth of dead organisms settled on the bottom was measured.

Two days prior to stocking, each pond was sprayed with 2 liters of a mixture of diesel fuel and gasoline (14 liters diesel fueld to 2 liters of gasoline). This mixture, applied from a knap-sack sprayer, was used to control predaceous aquatic insects. A second application was made 7 days after stocking.

Increasing the Sodium Chloride Concentration

Rock salt (Carey Southern Louisiana rock salt containing 99.08% sodium chloride) was added to 6 of 12 experimental ponds on March 27, 1972. Approximately 11,227 kg/ha of rock salt increased the chloride concentration from a range of 10 to 21 ppm to 550 ppm ±100 ppm (550 ppm chloride converted to salinity equals 1,000 ppm).

Water Quality

The chloride concentration of the water in the 6 ponds receiving rock salt was checked every 7 days with a Hach chemical kit (Model DR-EL). Water samples were collected at sunrise, and pH was determined in the laboratory with a Photovolt electronic pH meter (Model 126A). Surface dissolved oxygen concentrations were checked at sunrise once a week with a YSI oxygen meter (Model 51).

Experimental Fish

Striped bass fry were obtained on two separate occasions from the South Carolina Wildlife Resources Department Hatchery located near Moncks Corner, South Carolina. The fry, from two females, were transported by car in sealed plastic bags of water with an oxygen atmosphere. Each bag contained 15,000 to 20,000 fry. The plastic bags were transported in sealed styrofoam containers. Each trip took approximately 8 hours.

The first group of fry was received on April 8, 1972. The fry were 3 days old and had not absorbed their yolk sacs or developed mouth parts. Upon arrival at the Fisheries Research Unit, the plastic bags were floated in water of 1,000 ppm salinity and tempered for 30 minutes. Tempering was accomplished by slowly adding water to the bags. After tempering, the fry were poured into five Nalgene

containers (30.5 x 30.5 x 35.6 cm) filled with 6 liters of tempering water. The water was gently stirred to distribute fry while five 100 ml samples were taken. Fry counts from the five samples were averaged and used to determine the number of fry stocked in each pond.

Three ponds that received rock salt and three control ponds that did not receive rock salt were stocked with fry April 8, 1972 at a rate of 370,500 fish/ha (150,000 fish/acre). The fry were carried to the ponds and tempered for 30 minutes by slowly adding pond water to the Nalgene containers.

A second group of fry was received on May 16, 1972. These fish were 8 days old, had abosrbed their yolk sacs and were feeding. The fry were tempered and their numbers estimated in the manner described above. These fish were stocked May 16, 1972 at a rate of 197,600 fish/ha (80,000 fish/acre) in three ponds that received rock salt and in three control ponds.

Draining

Ponds containing fish stocked on April 8, 1972 were drained from May 24 to May 31, 1972. Two ponds were drained each day from sunrise to 0900 hours to prevent heat stress. The fingerlings were removed by seining. The number of days in the experiment ranged from 46 to 53.

Ponds containing fish stocked on May 16, 1972 were drained from June 27 to July 7, 1972. Due to high temperatures during this period, only one pond was drained each morning. The same procedure described earlier was used. The number of days in the experiment ranged from 42 to 52.

RESULTS AND DISCUSSION

Percentage survival in the 12 ponds ranged from 0 to 39.50% (Table 1). A total of 138,000 fry were stocked and 6,443 fingerlings were recovered for an overall survival of 4.67%. Mean survival for fish stocked April 8, 1972 was 1.41% in ponds that received rock salt and 0.10% in control ponds. Mean survival for fish stocked May 16, 1972 was 19.30% in ponds that received rock salt and 4.68% in control ponds.

Inspection of treatment means for the two groups of fish seemed to indicate a difference, but one that was not significant (.05 probability level). The results from stocking the 8 day old fry in the increased sodium chloride ponds was promising. The 39.50% survival was the highest striped bass fry survival at Auburn University.

There was a large difference in the mean survival of fry from the two parental females. This was thought to be due to the difference in fry quality, since a 5 day mortality rate in excess of 90% was observed in a portion of these fish that were received on April 8, 1972 and held in McDonald hatching jars (Catchings, 1973). Cause of this extreme mortality could not be determined. Temperature, pH, 02 and salinity remained within a range favorable for striped bass development during the period.

Increasing the sodium chloride concentration of pond water does not appear to be economical on a large scale. The cost of rock salt was approximately $650/ha. Additional research should be undertaken in areas where the water normally has a higher sodium chloride concentration.

Filamentous algae were a minor problem when the ponds were being seined to remove the fingerlings. Only one treatment of Diquat was applied to ponds containing fish stocked April 8, 1972. The fish were 30 days old at the time of application and according to previous striped bass experiments (Reeves, 1972) it was not thought that the addition of Diquat resulted in the lower survival in these ponds. No treatment was applied to the ponds containing fish stocked May 16, 1972. *Hydrodictyon* sp. was the most troublesome of the algae during the ex-

periment. It did not appear to grow as well in the ponds that received rock salt as in the control ponds.

Zooplankton populations in the ponds that received rock salt failed to reach the same magnitude as populations in the control ponds. Sample measurements recorded for ponds with increased sodium chloride water ranged from less than 0.5 mm to 2.1 mm with 66% of the measurements being less than 0.5 mm. Sample measurements recorded for control ponds ranged from less than 0.5 mm to 3.9 mm with only 14% of the measurements being less than 0.5 mm. This was not thought to be a critical factor in the experiment.

Dissolved oxygen concentrations remained high (3.0-13.4 ppm) in all ponds. The pH values (6.9 to 10.0) were found to be within the desirable range as described by Swingle (1969).

Trichodina wp. was the only parasite or disease problem during the experiment. Formalin effectively controlled the parasite.

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Table 1. Survival of Striped Bass Fry in Increased Sodium Chloride Water and Normal Sodium Chloride Water.

Treatment	3 day old fry Stocked April 8, 1972			8 day old fry Stocked May 16, 1972			Combined Survival Mean %
	No. Fish Recovered	Survival %	Mean Survival %	No. Fish Recovered	Survival %	Mean Survival %	
Increased Sodium Chloride	259	1.73		3,166	39.50		
	50	0.33		145	1.81		
	328	2.18		1,324	16.50		
			1.41			19.30	7.64
Normal Sodium Chloride	0	0.00		0	0.00		
	30	0.20		358	4.48		
	17	0.11		766	9.58		
			0.10			4.68	1.70
	Mean Group Survival % — 0.76			Mean Group Survival % — 11.99			