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TOXICITY OF SOME CHEMICALS TO STRIPED BASS *(Roccus saxatilis)*[1]

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ABSTRACT

The toxicity of eight chemicals to one week old and one month old striped bass, *Roccus saxatilis*, was determined. These chemicals included malachite green, acriflavine, formaldehyde, Diquat, sodium chloride, zinc, copper, and sodium sulfate. In addition the toxicity of artificial sea water and oil field brine based on chloride content was determined for one month old striped bass. Tests were conducted in one gallon wide mouth jars containing two liters of water. Reconstituted water held at 70 degrees Farenheit was used as the diluent. A wide range in toxicity between the two age groups was recorded for acriflavine, Diquat, sodium chloride and sodium sulfate. The one month old fingerlings were slightly more tolerant to malachite green, formaldehyde and copper than the larvae. Zinc was the only chemical tested that required a higher concentration to kill the larvae. The combinations of salts found in artificial sea water and oil field brine based on chloride content were less toxic than equivalent amounts of chloride as constituted from sodium chloride.

INTRODUCTION

Louisiana initiated a striped bass *(Roccus saxatilis)* stocking program in 1965. Since that time we have become interested in the effects of various water qualities, therapeutic agents and pollutants on striped bass. It is advantageous to stock fingerlings rather than fry. Methods of rearing, handling and treating these fish have to be developed. To kill aquatic vegetation in a pond, what can we use? To treat fish for parasites and diseases are the same chemicals and amounts commonly used in fish culture applicable? In what type of water quality will fingerlings survive?

These are just a few of the questions that have to be answered about striped bass before we initiate an intensive and extensive stocking program. The findings of this project will assist us and other research workers in obtaining the information necessary to achieve better survival in our striped bass stocking programs in Louisiana and other states.

[1]This study was financed, in part, by Louisiana Federal Aid in Fish Restoration Project F-15-1.

MATERIALS AND METHODS

Bioassay techniques used followed in general those outlined by Doudoroff, et al. (1951). The striped bass used for these tests were obtained as larvae from the South Carolina Wildlife Resources Department Hatchery at Moncks Corner. Our Commission airplane transported the larvae in plastic bags, containing water and oxygen, which were packed in styrofoam containers. Approximately six hours of flying time were required to transport the fish to the Monroe Fish Hatchery in Louisiana. After the fish were tempered for one hour they were placed in wooden troughs at the rate of 1000 fish per gallon of water. Striped bass larvae are unable to support themselves in the water column until they are four days old. Therefore, filtered lake water (70°Farenheit) was forced through a hose attached to the bottom of the trough causing a boiling motion of the water which kept the larvae suspended.

When the fish were one week old, they were removed from the trough by the use of a glass siphon tube and ten fish were placed in each bioassay container. These containers were one gallon wide mouth glass jars, partially submerged in a 70°F water bath. One liter of reconstituted water was used as the diluent (Table 1). The dilution water was aerated for fifteen minutes before the fish were added. No aeration was conducted during the tests.

TABLE 1.
Reconstituted Water Used for Bioassays

Chemical	*Grams per liter*
Calcium sulfate, $CaSO_4.2H_2O$	0.035
Magnesium sulfate, $MgSO_4.7H_2O$	0.035
Sodium bicarbonate, $NaHCO^3$	0.055
Potassium chloride, KOl	0.002

One month old striped bass (30 mm to 52 mm in length) were obtained from stocked ponds at our Monroe Fish Hatchery. A short seine haul was made to prevent over crowding of the fish in the net. The fish were dipped from the net with a plastic scoop and poured into a three gallon plastic tub. The fish were removed from the tub by hand and two fish were placed in each bioassay jar which contained two liters of reconstituted water. The test chemicals were added after the fish had been in the containers for 24 hours.

Graduated concentrations of the chemicals tested were added to each container all at one time. One control for each ten bioassay containers was used. Replicate tests were conducted for each concentration. The live and dead fish were checked and recorded at the end of each 24 hour period for 96 hours.

Chemicals tested included malachite green, acriflavine, formaldehyde, Diquat (1, 1-ethylene-2, 2-dipyridilium dibromide), zinc (prepared from zinc chloride), copper (prepared from cupric chloride), sulfate (prepared from sodium sulfate), chloride (prepared from sodium chloride), Instant Sea (a commercial product prepared by Jungle Laboratories, Orlando, Florida) and oil field brine waste.

RESULTS AND DISCUSSION

The toxicity of eight chemicals to one week old larvae and ten chemicals to one month old fingerlings are presented in Tables 2 and 3 respectively.

Malachite green is recommended for the control of fungus on fish at 0.1 parts per million (ppm) for an indefinite period by Snieszko and Hoffman (1963). Jones (1965) found that 90 percent mortality of black bass fry occurred at 0.025 ppm malachite green between 27 and 51 hours. Striped bass larvae are more tolerant than black bass fry, however concentrations greater than 0.025 ppm should not be used for long term treatments. Striped bass fingerlings can tolerate the recommended rate of 0.1 ppm for a 96 hour period.

Striped bass fingerlings are more tolerant to acriflavine than the larvae. The recommended rate of 2-5 ppm for 1-4 hours to kill external protozoa (Snieszko and Hoffman, 1963) could be safely used for both age fish. If striped bass larvae are to be

TABLE 2

Toxicity of Chemicals to One Week Old Striped Bass Reported in Parts Per Million.

Chemical	*24 hours*	*48 hours*	*72 hours*	*96 hours*
Malachite green				
All Alive	0.05	0.025	0.025	0.025
LC_{50}	0.1	0.05	0.05	0.05
All Dead	0.2	0.1	0.1	0.1
Acriflavine				
All Alive	3.0	3.0	3.0	3.0
LC_{50}	5.0	5.0	5.0	5.0
All Dead	15.0	15.0	15.0	15.0
Formaldehyde				
All Alive	10.0	10.0	10.0	5.0
LC_{50}	15.0	15.0	15.0	10.0
All Dead	35.0	30.0	30.0	30.0
Diquat				
All Alive	0.1	0.1	0.1	0.1
LC_{50}	1.0	1.0	1.0	1.0
All Dead	5.0	5.0	5.0	5.0
Zinc				
All Alive	0.05	0.01	0.01	0.01
LC_{50}	0.5	0.1	0.1	0.1
All Dead	$>$0.5	0.3	0.3	0.3
Copper				
All Alive	0.01	0.01	0.01	0.01
LC_{50}	0.1	0.05	0.05	0.05
All Dead	0.2	0.1	0.1	0.1
Sulfate				
All Alive	500	100	100	100
LC_{50}	2000	1000	500	250
All Dead	$>$2000	$>$2000	2000	1000
Chloride				
All Alive	1000	$<$1000	$<$1000	$<$1000
LC_{50}	3000	1500	1000	1000
All Dead	4000	2000	2000	2000

treated for longer than four hours, 3 ppm or less acriflavine should be used. Jones (1965) reported that channel catfish fry and bluegill fry can tolerate 5 ppm acriflavine. Striped bass larvae are less tolerant to acriflavine than channel catfish.

Formaldehyde at 15 ppm has been recommended as a pond treatment for the control of ectoparasites (Allison, 1957). This treatment cannot be recommended for striped bass larvae or fingerlings. In 96 hours the LC_{50} for larvae is 10 ppm and for fingerlings is 15 ppm. Striped bass fingerlings can tolerate higher concentrations than larvae for 24 hours but for the remainder of the 96 hour period toxicities are approximately the same. These results compare favorably to those of Regan, et al. (1968). For striped bass fingerlings, they found the 96 hour LC_{50} to be 18 ppm.

Diquat was found to have a 96 hour LC_{50} of 80 ppm to striped bass fingerlings by Regan, et al. (1968) and a 96 hour LD_{10} of 10 ppm to bluegill by Lawrence, et al. (1965). I found this herbicide to be more toxic to both larvae and fingerling striped bass than either of these. The 96 hour LC_{50} for fingerlings was 10 ppm and for larvae was 1.0 ppm. All larvae survived in 0.1 ppm. Diquat is used at rates of 0.5 ppm or 1-2 gallons per surface acre. This concentration would be acceptable in ponds containing striped bass fingerlings, but should not be used in ponds containing striped bass larvae.

TABLE 3

Toxicity of Chemicals to One Month Old Striped Bass Reported in Parts Per Million.

Chemical	*24 hours*	*48 hours*	*72 hours*	*96 hours*
Malachite green				
All Alive	0.1	0.1	0.1	0.1
LC_{50}	0.2	0.2	0.2	0.2
All Dead	0.25	0.25	0.25	0.25
Acriflavine				
All Alive	25	25	25	25
LC_{50}	30	30	28	27.5
All Dead	35	35	30	30
Formaldehyde				
All Alive	25	10	10	10
LC_{50}	35	15	15	15
All Dead	40	25	25	25
Diquat				
All Alive	30	15	10	5
LC_{50}	35	25	15	10
All Dead	40	35	20	15
Zinc				
All Alive	0.05	0.05	0.05	0.05
LC_{50}	0.20	0.1	0.1	0.1
All Dead	0.25	0.2	0.2	0.2
Copper				
All Alive	0.05	0.05	0.03	0.03
LC_{50}	0.10	0.08	0.05	0.05
All Dead	0.25	0.1	0.1	0.1
Sulfate				
All Alive	2500	2500	2500	2500
LC_{50}	3500	3500	3500	3500
All Dead	4500	4500	4500	4500
Chloride				
All Alive	7000	4000	4000	4000
LC_{50}	$>$7000	5000	5000	5000
All Dead	$>$7000	6000	6000	6000
Instant Sea[1]				
All Alive	17,000	17,000	17,000	17,000
All Dead	22,000	22,000	22,000	22,000
Oil field brine[1]				
All Alive	16,600	16,600	16,600	16,600
All Dead	18,800	18,800	18,800	18,800

[1] Reported as ppm chloride

A higher concentration of zinc was required to kill all striped bass larvae than fingerlings. However, 100 percent of the fingerlings survived in a higher concentration than the larvae. Water recirculated through galvanized pipe or held for long periods of time in galvanized tubs can contain sufficient zinc to kill striped bass. We experienced mortalities of striped bass caused by 0.28 ppm of zinc in our water supply. Other species of fish, ie; bluegill, channel catfish and largemouth bass were not killed. This agrees with Patrick et al. (1968) who reported a 96 hour TL_m of 2.86-3.78 ppm for bluegill.

Copper was also very toxic to both striped bass larvae and fingerlings. The 96 hour LC_{50} for both size fish was 0.05 ppm. Bluegill are more tolerant to copper than striped bass. Patrick, et al. (1968) found the 96 hour TL_m to bluegill to be 1.25 ppm. Recirculating water through copper pipe should be avoided for striped bass.

Sulfate was more toxic to larvae than fingerlings. The 96 hour LC_{50} for larvae was 250 ppm and 3500 ppm for fingerlings. Sulfates should not cause high mortalities of striped bass in natural waters.

Tatum, et al. (1966) found a 24 hour TL_m of 4830 ppm salt (NaCl) for striped bass fingerlings. I found the 24 hour LC_{50} of chloride on striped bass fingerlings to be greater than 7000 ppm. However, the 96 hour LC_{50} was 5000 ppm. Chloride is more toxic to larvae than fingerlings. The 96 hour LC_{50} for larvae was 1000 ppm. Further studies have indicated that striped bass can tolerate even higher concentrations of chloride as they increase in size.

Instant Sea and oil field brine waste, as reported in ppm chloride, were less toxic to striped bass fingerlings than sodium chloride. All fingerlings survived in 96 hours in Instant Sea at 17,000 ppm chloride and in oil field brine waste at 16,600 ppm chloride. Instant Sea was added to hauling tanks containing striped bass fingerlings at the rates of 2500 ppm and 5000 ppm chloride. The survival in 18 hours was higher in these tanks than others containing either acriflavine, sodium chloride or fresh water. Some oil field brine waste contains more than 40,000 ppm chloride which would be very toxic to striped bass. However, with dilution of this waste product, striped bass are able to withstand more oil field brine pollution than most of our other freshwater species.

ACKNOWLEDGMENTS

I wish to express my appreciation to James T. Davis, Fisheries Research Supervisor, Louisiana Wildlife and Fisheries Commission for his assistance in this project and his critical review of the manuscript. I also wish to acknowledge Harry E. Schafer, Jr., Chief of Fisheries, Louisiana Wildlife and Fisheries Commission, for his support throughout the project. Thanks are also due to Dr. David S. Byrd, Professor of Chemistry, Northeast Louisiana State College, for his assistance in the initial planning of chemical preparations.

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