Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Effects of Disease Treatments on Growth of Razorback Sucker

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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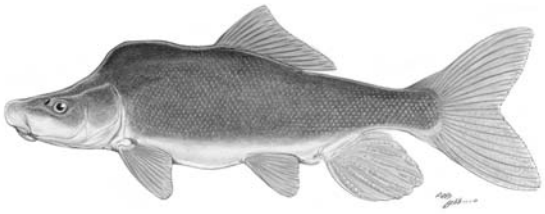

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Abstract

Formalin, copper sulfate, potassium permanganate and salt are all chemicals commonly used to treat *Ichthyophthirius multifiliis* outbreaks in captive razorback sucker (*Xyrauchen texanus*). We exposed 190 juvenile razorback suckers (127 – 262 mm TL) to 5, 5-day treatments with each chemical to evaluate the effects these chemicals may have on growth. Fish grew an average of 23.5 mm TL during the 3 month study period. Fish treated with formalin grew on overage 29 mm TL (0.3 mm/day), while fish treated with copper had the lowest growth averaging 20 mm TL (0.21 mm/day). No significant differences in growth were observed among fish treated with any of the chemicals compared to untreated fish (p>0.05). Reductions in growth as a result of repeated chemical treatments are not likely the cause of differences in growth rates among facilities that raise razorback suckers. Repeated chemical treatments may have other impacts to overall fitness or long-term survival but these effects were not evident in our study.

Introduction

Preservation of razorback sucker (*Xyrauchen texanus*) currently depends on captive rearing and stocking programs until permanent solutions to factors that prevent wild recruitment are found. Low survival of stocked razorback suckers (Brooks 1986, Marsh and Brooks 1989, Marsh and Pacey 2005) has caused target sizes for stocked fish to steadily increase in efforts to reduce predation mortality (Marsh et al. 2005, Schooley and Marsh 2007). Rearing fish to larger sizes at hatcheries comes with increased costs and creates the need to evaluate husbandry and rearing practices that may affect fish growth. Formalin, copper sulfate, potassium permanganate and salt are all chemicals commonly used at razorback sucker rearing facilities to treat outbreaks of the protozoan parasite *Ichthyophthirius multifiliis*. "Ich" is one of the most pathenogenic diseases of cultured freshwater fishes (Matthews 2005) and causes large losses in captive populations of endangered razorback sucker. Each of these chemicals used to treat Ich only kill the free swimming life stage of the parasite, requiring repeated doses over several days depending on water temperature. These chemicals treatments are needed to prevent loss as a result of disease outbreaks, but the cumulative effects repeated disease treatments have on growth are unknown.

Copper sulfate has been shown to significantly reduce growth of channel catfish in production ponds (Rabago-Castro 2006), but it is unknown whether razorback suckers experience similar reduced growth following copper treatment. Quantifying the impacts of disease treatments on growth will help to interpret the wide differences in growth rates observed at various razorback sucker production facilities throughout the southwest (Ward et al. 2007). If one chemical is found to have less detrimental impacts on growth

than another then it may be preferred for use as a disease treatment. We evaluated growth rates of razorback suckers under replicated and controlled conditions to assess effects of repeated formalin, copper sulfate and potassium permanganate and salt treatments on growth.

Methods

We captured 190 juvenile razorback suckers from ponds at Bubbling Ponds Fish Hatchery, AZ using hoop nets or cast nets. All fish were of the same age class and averaged 179 mm total length (TL) (range = 127 – 262 mm TL) (Table 1). These fish were offspring of captive razorback sucker broodstock held at Dexter National Fish Hatchery, NM. (2007 year class). All fish were tagged with passive integrated transponder (PIT) tags and quarantined for one month prior to the experiment to allow fish to recover from tagging and become accustomed to being held in circular tanks.

At the beginning of the study all fish were weighed, measured and scanned for individual tag numbers with 19 randomly selected fish placed into each of 10, 8-foot diameter circular tanks (Figure 1). Each tank contained two airstones and an individual biofilter with a recirculating water pump (31 liters/minute) that had been operating for at least 1 month prior to the experiment to allow bacterial colonies to become established. Two tanks were designated as a control and did not receive any chemical treatments while the other eight tanks received formalin, copper sulfate, potassium permanganate, or salt treatments at two week intervals (two tanks per chemical treatment). Formalin, copper sulfate and potassium permanganate were treated at 1 part per million (ppm) and salt was applied at 3.0 parts per thousand (ppt). These treatment rates are commonly

used to treat razorback suckers for ich at Bubbling Ponds Fish hatchery (Frank Agygos, personal communication).

Each treatment consisted of a series of doses applied on Wednesday, Thursday and Friday with a 90% water change between each dose. Biofilters were removed from all tanks and held in a separate holding facility during treatments and then replaced on the Monday following treatments after a 90% water change. This schedule allowed fish to be exposed to chemical treatments for 5 consecutive days without water quality deteriorating. This 5-day chemical treatment was repeated every two weeks from July to October (97 days) for a total of 5, 5-day treatments. Water temperature in the treatment tanks ranged from 13°C (55°F) to 32°C (91°F).

Fish were fed a fixed ration of commercial razorback diet (Silvercup, 4mm pellet) once daily (2 % percent body weight per day as calculated by average initial fish weight). At the end of the experiment all fish were again weighed, measured and scanned for individual tag numbers. Growth of fish in each treatment group was compared using analysis of variance (ANOVA). Any mortalities that occurred during the study were replaced with previously quarantined fish of equivalent size to maintain equal densities in each tank, but growth data was only recorded for fish which survived the entire experiment.

Results

Fish at the start of the experiment averaged 179 mm TL (Range = 127 – 262 mm) (Table 1) with no significant differences in fish length among treatment groups ($F_{(4,189)}$ = 0.0183, $p > 0.999$ ANOVA). On average fish grew 23.5 mm TL (0.24 mm/day) during the 3 month study. Fish in tanks treated with formalin had the highest growth averaging

29 mm TL(0.3 mm/day) while fish in tanks treated with copper had the lowest growth averaging 20 mm TL (0.21 mm/day). Fish in the control tanks averaged 21.3 mm TL in growth (0.22 mm/day) (Figure 2). No significant differences in growth in length or weight were observed among fish treated with any of the chemicals compared to untreated fish ($p>0.05$, ANOVA).

Discussion

Growth rates observed in our study (0.21 – 0.3 mm/day) are low compared to those reported in other studies of razorback sucker growth (0.2 – 1.8 mm/day) (Ward et al. 2007). Using recirculating water systems for our study required filters to be removed and replaced during treatments. Stress to fish caused by removing and replacing filters within the tanks as well as repeated water changes may have led to overall higher stress and reduced growth rates compared to those reported for unconfined fish. Growth in fish is highly variable and is affected by many different physiological and environmental factors including fish size, density, temperature, amount of space, and food (Brett 1979). We strived to control each of these factors, but other factors may have also influenced growth in our experimental tanks. During mid-summer, water temperatures in the treatment tanks reached 32°C (91°F). At these warm temperatures fish are very susceptible to bacterial infections. The slightly higher growth exhibited by fish in the formalin and potassium permanganate treatments may have been the result of these two chemicals being effective at controlling bacterial infections. The differences in growth we measured among treatment groups were not statistically significant and do not appear biologically meaningful during the relatively short duration of this study (97 days),

although the cumulative effects of slightly reduced growth could be biologically meaningful over longer time frames.

Reductions in growth as a result of repeated chemical treatments are not likely the cause of differences in growth rates among facilities that raise razorback suckers. Repeated chemical treatments may have other impacts to overall fitness or long-term survival but these effects were not evident in our study. It is more likely that the parasite outbreaks themselves are the cause of different growth rates among razorback rearing facilities rather than the chemical treatments used to treat the parasites. We recommend that hatchery managers continue to use the chemicals that are most effective at controlling "Ich" at their individual facilities.

Acknowledgements

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Table 1. Number and initial sizes of razorback suckers used in experiments to evaluate effects of repeated chemical treatments on growth.

		Total Length, mm	
Treatment	Number	Mean	(Range)
Control 1	19	178.7895	133 - 259
Control 2	19	180.7368	149 - 211
Copper 1	19	179.2632	134 - 251
Copper 2	19	177.5789	136 - 255
Formalin 1	19	180.1053	143 - 223
Formalin 2	19	177.5263	145 - 217
Potassium 1	19	180.4211	143 - 220
Potassium 2	19	178.8947	127 - 262
Salt 1	19	177.6842	140 - 255
Salt 2	19	180.5263	137 - 224

Figure 1. Photo of experimental tanks with individual biofilters and aeration.

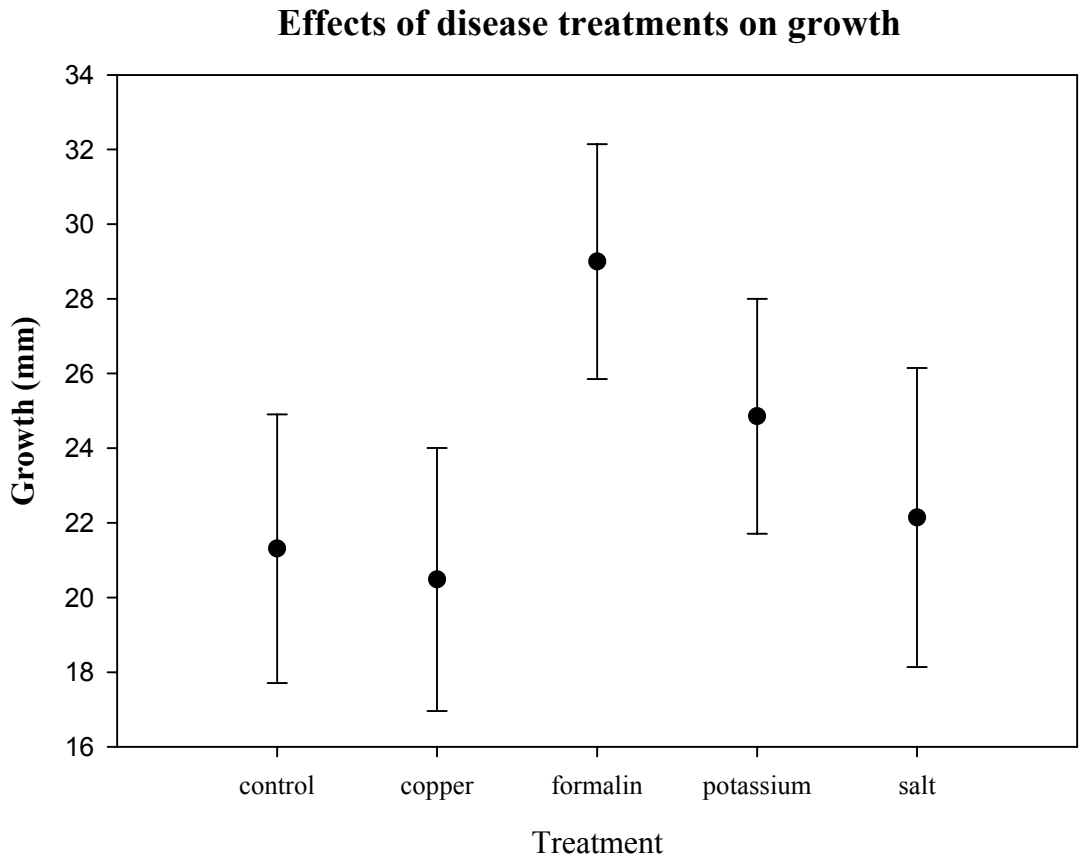

Figure 2. Average growth of razorback suckers exposed to a series of 5, 5-day chemical treatments over a 97-day period. Error bars represent 95% confidence intervals.

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