The Effects of Lead Exposure on Fathead Minnows

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Abstract

This experiment was designed to determine the effects of lead on the reproduction of fathead minnows. This data can be used to further educate people on the harmful effects of lead on reproduction. The impacts of lead exposure observed in the fathead minnows may indicate similar effects in humans or other organisms. Our data indicates that the fathead minnows that were exposed to lead showed increased reproductive behaviors despite our research suggesting that lead has adverse effects on reproduction.

Introduction

Lead is a toxic metal and been shown to affect behavior causing physical and behavioral abnormalities including irritability, learning disabilities, and developmental deformities (1). Lead becomes absorbed into the body and distributed into the bloodstream by mining, smelting, manufacturing, and recycling. Additionally, people are exposed to it on a day-to-day basis through paint chips, gasoline, and lead-acid batteries. For both humans and fish, male hormone levels are reduced as lead enters the body (1). Studies have shown that the presence of lead in fathead minnows environment causes a retardation in the development of reproductive organs as well a decrease in the secondary sex characteristics in males (1). It was hypothesised that the lead exposed environment would lead to a decrease of secondary sexual characteristics as well as nest preparing and spawning behaviors.

Methods and Materials (2)

1.Two tanks were set up. Tank #1 contained lead nitrate concentration of 1 ppm of lead nitrate in the water for 2 weeks prior to the experiment. Tank #2 contained no lead nitrate.

2.Each of the two tanks were divided into three separate sections. Two fathead minnows (one male and one female) were placed into each section, totalling 6 minnows in each tank

3.Documented the male minnows secondary sex characteristics and behaviors for seven days (every other day) at 5 minutes for each observation

4.Calculated the standard errors of the mean and did a Fisher test on the control and lead environments to see if the differences in the data presented in figures 2 and 3 were significant.

Fig 1: Shows a picture of a male fathead minnow from the lead exposed environment.

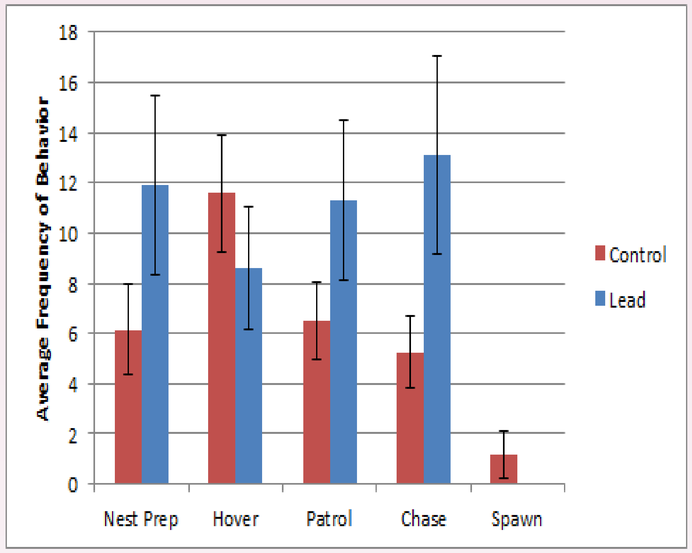

Fig 2: Shows the frequency of reproductive behavior observed in both control and lead tanks. The independent variable in this experiment was the exposure to lead in fathead minnows. The dependent variable was reproductive behavior. The control variable was a tank with fathead minnows that were not exposed to lead. +/- 1 SEM showed that the difference in all reproductive behaviors were significant except hovers.

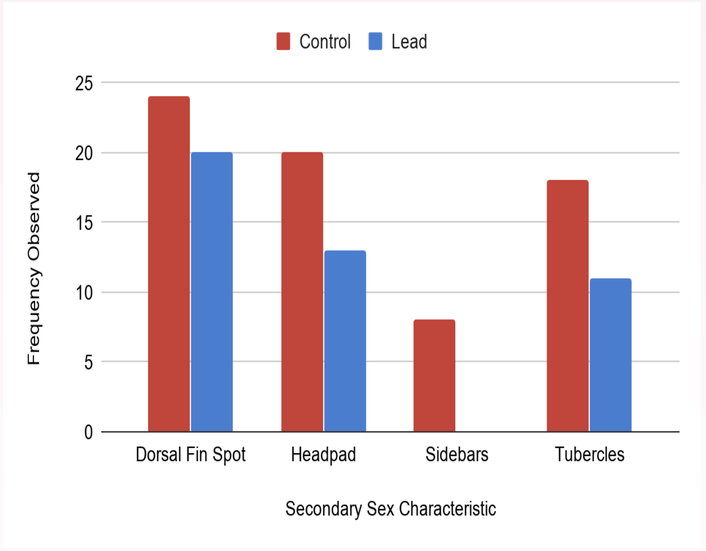

Fig 3: Shows the frequency of secondary sex-linked characteristics observed in both control and lead tanks. Results from a Fisher test show that lead exposed minnows had a significant decrease in tubercles compared to minnows that were not exposed to lead. ($p < 0.0014$) All the other characteristics did not show any significant differences.

Discussion

In this experiment, we found our original hypothesis to be partially correct. We predicted that the male fathead minnows exposed to lead would have a decrease in secondary sex characteristics. Our data clearly shows that the lead exposed minnow displayed the same amount of these sex characteristics such as head pads, side bars, tubercles, and dorsal fin spots. It was also hypothesized that the minnows exposed to lead would have a decrease in reproductive behaviors. It is shown in figure 2 that our data fails to support our hypothesis. A higher amount of reproductive social behaviors in the male fathead minnows in the lead exposed group such as nest prep, patrol and chase were observed. The control group shows more of the behaviors hover and spawning. This data does not support the previous published research that lead can disturb the development of male reproductive organs. One limitation observed in this experiment includes the duration of time that the observation of fish took place. An elongation of the duration of time in this experiment would yield more accurate data to create more distinct conclusions. Additionally, any errors in our experiment are attributable to observing different tank sections at an unequal number of times due to random assignment leading to the potential for one tank of minnows to be observed more often than the other.

References

1.Weber, Daniel N.Exposure to sublethal levels of waterborne lead alters reproductive behavior patterns in fathead minnows*(Pimephales promelas*) *Neurotoxicology,* vol.14 no. 2-3, 1993, pp347-58. https://www.ncbi.nlm.nih.gov/pubmed/8247408

2.Petering, David H. “Integrating Physiology and Behavior: Using Fathead Minnows to Model the Effects of Environmental Agents.” *Integrating Physiology and Behavior: Using Fathead Minnows to Model the Effects of Environmental Agents*, 2012, pp. 1–138.