The Effect of Lead Exposure on Reproductive Activity in Male Fathead Minnows

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Abstract

Around the world, common drinking water has been known to become contaminated with lead. Lead pipes have been known to cause this contamination. Lead exposure is one of the greatest risks to alter brain development. Lead exposure can also lead to varying male reproductive behavior. In this experiment, the effects of lead on male reproductive behaviors of fathead minnows were tested and found inconclusive results. However, these results may explain some effects lead can have on human reproductive behaviors.

Introduction

Lead poisoning and exposure continue to impact households around the world. People can be exposed to lead poisoning through work, water, paint, and household dust. Lead poisoning comes with a number of adverse effects including developmental and reproductive issues. It is important to understand the effects of lead on development and more specifically reproductive health in order to ensure the safety of future generations. In order to investigate these issues further, an experiment will be conducted on fathead minnows. Fathead minnows are a good subject to study because of their easily identified reproductive characteristics. Reported effects in men include reduced libido, effects on spermatogenesis (reduced motility and numbers, increased normal morphology), chromosomal damage, infertility, abnormal prostatic function and changes in serum testosterone (2). Although evidence is conflicting, it has been reported that accumulation of lead affects the majority of the endocrine glands (1). Overall, it is hypotheseized that with exposure to lead, fathead minnows are less likely to display secondary sex (such as verticle banding, dorsal fin spots, head pads, and tubercles) characteristics and participate in reproductive behaviors (such as hovering and nest preparation).

References

1. Doumouchtsis, K. K., et al. “The Effect of Lead Intoxication on Endocrine Functions - Journal of Endocrinological Investigation.” *SpringerLink*, Springer International Publishing, 22 Mar. 2014, link.springer.com/article/10.1007/BF03345710.
2. PMC, Europe. *Europe PMC*, europepmc.org/article/med/8247405.

Wang, Yinxian, et al. “The Effects of Chronic Exposure to Environmentally Relevant Levels of Waterborne Cadmium on

Figure 1:

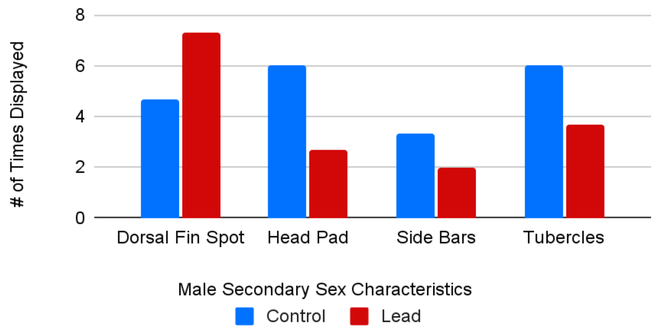

Figure 1 compares the asecondary sex characteristics between the control male fatheaded minnows and the lead exposedmale fatheaded minnows.

Figure 2:

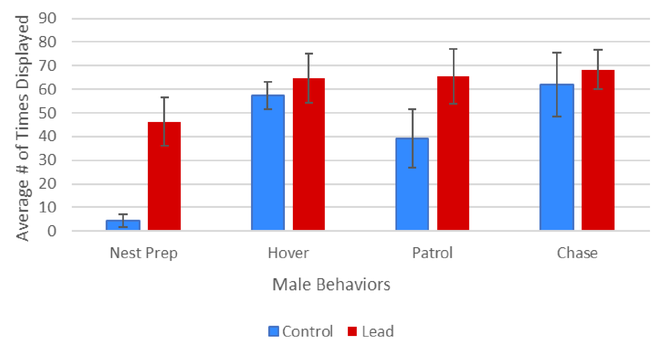

Figure 2 compares the average reproductive behaviors between the control male fathead minnows and the lead exposed male fathead minnows. Error Bars indicate one SEM.

Materials & Methods

Two fish tanks were divided into three separate sections using plastic dividers. Each section contained a female and a male fathead minnow as well as a breeding chamber. A breeding chamber is a PVC pipe cut in half, as an arch. In tank one, fish were raised normally without exposure to lead. Observations were done blindly, meaning tanks were not identified by lead exposure until observations were over. Three different sections of male fish were observed seven times over two weeks. Every day the fatheaded minnows were observed, the male’s secondary sex characteristics were identified and their reproductive behaviors were tallied. The male’s secondary sex characteristics include: dorsal fin spot, head pad, side bars, and tubericles. The male’s tallied reproductive behaviors include: nest preparation, hover, patrol, chase, and spawn (*Figure 3)*. After observations were collected, averages, standard error of the mean, and the Fischer test were evaluated, the null hypothesis was either accepted or rejected.

- Data Collection Packet
- Timer
- 2 fish tanks with 2 dividers (3 spaces) in each
- Water
- 2 Heaters
- 12 fish total(6 lead exposed, 6 control)
- 6 Breeding chambers

Figure 3:

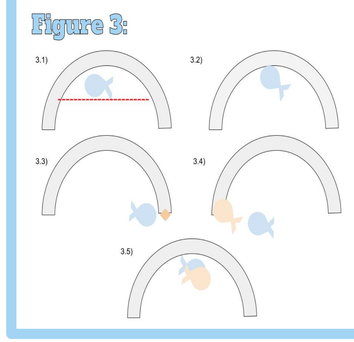

Figure 3 displays examples of different male reproductive behaviors. *Figure 3.1* displays an example of a hover which is when a male hovers above the top half of the breeding chamber. *Figure 3.2* displays an example of nest preparation, which is when a male prepares the breeding chamber so the female can lay her eggs. *Figure 3.3* displays a patrol which is when the male exits the breeding chamber to get food or guard the surrounding area. Patrolling is not considered a reproductive behavior and may be considered a hindrance in reproductive activity. *Figure 3.4* displays a chase which is when the male chases the female in order to engage in reproductive activities. *Figure 3.5* displays a spawn, which is when the male flips the female over so she can lay her eggs on the breeding chamber.

Discussion

Our hypothesis states that fathead minnows that were exposed to lead would display fewer secondary sex characteristics and were less likely to perform reproductive behaviors. In *Figure 2*, it was observed that the error bars overlap when looking at hovers and chases (see *Figure 3.3*). This means that lead had an insignificant effect on the behavior of hovers and chases. However, there was a significant effect of lead on nest preparation and patrol behavior among males (see *Figure 3*). Behaviors such as patrolling, having been displayed more often by lead exposed fathead minnows, this is not a reproductive characteristic. It is possible that lead could affect the focus and attention the fish had, meaning that rather than focusing on reproducing they were more likely to search for food or get distracted by other fish. Looking at our data on nest preparations (see *Figure 2*), lead exposed fathead minnows displayed a significantly greater number of nest preps in comparison to the control group which was unexpected. Nest preps, unlike patrols, are crucial to the fishs’ reproductive process. Our data on male behaviors does not support our alternative hypothesis. Utilizing data from *Figure 1*, we used a Fischer test to determine the significance of lead on male fathead minnow secondary sex characteristics. With the Fischer test we were able to identify a trend in which lead significantly decreased the amount of times males displayed secondary sex characteristics. Our data on the effect of lead on male fathead minnow secondary sex characteristics and on male fathead minnow behaviors was contradictory. It is possible that other things could have interfered with this experiment’s results such as: sample size, and age of the fish.

Results

The results of this experiment appear to be sporadic in some areas and similar in other areas. Data from all class periods were combined and averaged to have a larger sample size for this experiment. We utilized a Fischer test to understand data from secondary sex characteristics to determine if lead was relevant to certain characteristics or not. According to a Fischer test we determined that lead had no significant effect on secondary sex characteristics of fathead minnows. Results were varied between *Figure 1* and *Figure 2*, data appeared to show increased activity in lead exposed minnows more than control groups of minnows.