CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Alexandra N. Vredenburgh

Project Number

S1131

Project Title

Ocean Water Quality: Evaluating the Environmental Impact of Protective Boat Coatings on Marine Life

Abstract

Objectives/Goals

Boat paint companies argue that copper antifouling paints do not harm marine life, even claiming that copper is an essential micronutrient to life. This study independently evaluates this claim to determine the effects of copper paints on the aquatic environment. While most literature focuses on larger organisms such as mammals and fish, this study evaluated smaller organisms, planarian and egeria densa, that are lower on the food chain.

Methods/Materials

Create dilutions of copper sulfate solution (all in ppm): 0.001, 0.01, 0.01, 0.1, 0.2, 0.5, 3.0. Place 20 planarian in each 30 ml petri dish with 20 ml of each copper solution. Place 5 cm segment of egeria densa in each 50 ml conical tube filled with copper solution (Phase 1: control, 0.2 ppm, 0.5 ppm, 3.0 ppm; 2nd phase: control, 0.001 ppm, 0.01 ppm). For regeneration study, cut 10 planarian per experimental condition in half using scalpel and expose 20 planarian segments per condition to copper solution (control, 0.001 ppm, and 0.01 ppm). Study all specimens under microscope. Document changes to structures, behavior, and mortality rates.

Results

No difference in mortality rates for copper levels up to 0.5 ppm for uncut planarian; however, there was a negative impact on their health such as loss of eye spots and behavioral changes for the 0.5 ppm exposed planarian, indicating that copper affected the test organisms. The regeneration study suggests that the level of copper found in the San Diego Yacht Harbor (0.01 ppm) had a significant impact on ability to regenerate (85% death within 8 days, compared to 15% death for EPA control). Microscopic study indicated a change in the cellular biology of the egeria densa in all levels of copper, including the EPA allowed level of 0.001 ppm.

Conclusions/Discussion

When dissolved copper was introduced to aquatic plants (egeria densa) at levels of exposure found at the Shelter Island Basin, there was an effect on the cellular biology when compared to unexposed plants, and those exposed at the EPA level. While the EPA allowed copper level did not appear to affect planarian regeneration rates, the copper level found at Shelter Island caused significant mortality rates. Therefore, the boat paint company#s claim that copper was not harmful to marine life was misleading. These organisms are a very important part of the ecosystems they support, and their demise would be catastrophic within the food chain.

Summary Statement

This study evaluated the environmental impact of copper on planarian and egeria densa.

Help Received

Lab equipment was borrowed from Rancho Buena Vista High School. My father supervised dissections and chemical disposal.