Floating Treatment Wetlands May Remove BPA

Project Location: Test Tanks, Billings, Montana USA

This case study suggests that BioHaven floating island technology can reduce concentrations of the endocrine disruptor Bisphenol-A (BPA) in water. It appears likely that a microbial biofilm growing on and around the island in this study degraded BPA below the initial concentration of 50 ng/L.

Overview

One of the most common estrogen mimickers is known as Bisphenol-A (BPA), a chemical commonly used in production of plastics and epoxy resins. BPA has been directly linked to gender ambiguity in fish. BPA is one of many man-made chemicals that have been recently detected in the nation's waterways through use of more sensitive analytical techniques. Along with pharmaceuticals, concentrations of estrogens and their mimickers have been detected well above background levels.

Previous studies showed that BioHaven floating treatment wetlands (FTWs) will remove contaminants such as nitrogen, phosphorus, biochemical oxygen demand (BOD), total suspended solids (TSS) and propylene glycol from water. The focus of this test was to determine whether a BioHaven could reduce levels of BPA, as measured by gill flares exhibited by male betta (beta) fish.

Background

In 2008, two Billings West High School students, along with their academic advisor, began studying the behavioral effects of estrogen sulfate and BPA. Their initial data showed that either chemical reduced aggression levels of male *Betta splendens,* the Siamese fighting fish commonly known as betta fish. The focus of their last test was to investigate the effects BPA has on the aggression levels of male bettas in the presence of a BioHaven.

Two small BioHavens (approximately 2 feet long x 1 feet wide x 6 inches thick) were planted with potting soil and a wildflower mix. After the FTWs were grown for two weeks, BPA was added to water at a concentration of 50 ng/L. The following test conditions were run:

Condition	BPA Present	FTW Present
1	---	---
2	X	---
3	---	X
4	X	X

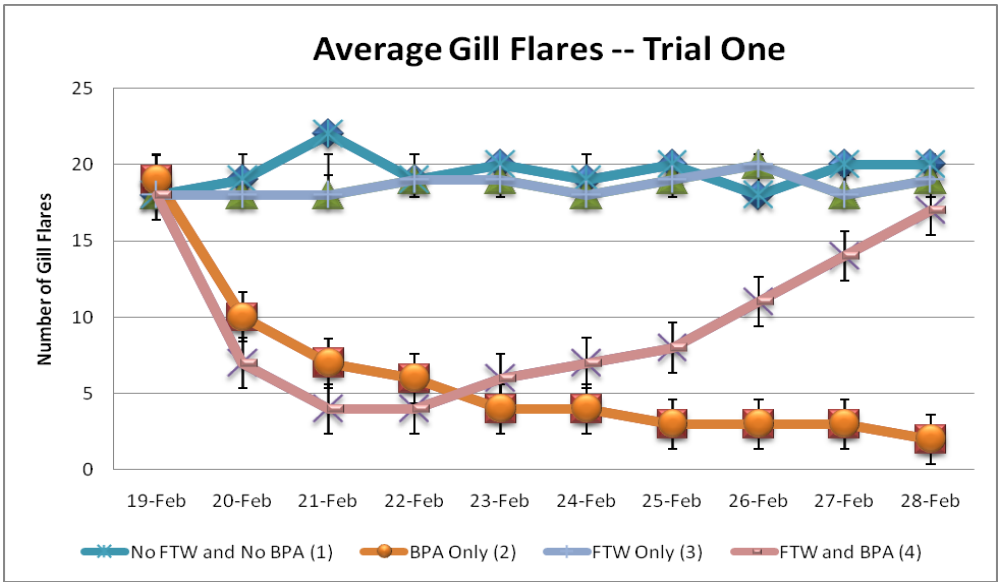
Condition 4 was the actual experiment with BPA in the presence of the FTW, with the other three conditions serving as controls. To measure gill flaring, male betta fish (three per condition) were exposed to a mirror for two minutes while gill flares were tallied. It was beyond the scope and budget of the test to directly monitor BPA concentrations.

Results

Condition 1, the first of the three control groups, did not contain BPA or an FTW. This group exhibited an average of 20 gill flares in two minutes, which is consistent with data collected in an earlier study. Therefore, 20 gill flares was the baseline.

Condition 2 contained BPA with no FTW. Results from this test agreed with the previous year's data, in that gill flares were reduced from 20 to an average of 6. A standard t-test showed that this was a statistically significant difference at a 95% confidence level. In condition 3, with an FTW but no BPA, male bettas exhibited an average of 19 gill flares per two-minute time trial, which is statistically equivalent to the baseline.

The experimental group (condition 4) exhibited significantly fewer gill flares after one day of exposure to BPA, similar to condition 2. After three days, however, the male betta aggression level (as measured by gill flaring) steadily rose until reaching the baseline of approximately 20 flares in two minutes. The experiment was repeated a week later, with very similar results.



Conclusions

This test confirmed earlier findings that the presence of BPA in water at a concentration of 50 ng/L significantly reduces aggression levels of male betta fish, as measured by the number of gill flares. The test also showed, in two replicates, that aggression levels increased to normal in the presence of a BioHaven floating treatment wetland (FTW). One possible explanation is that roots of the plants growing on the BioHaven absorbed BPA, thereby removing it from the aquatic system. A more likely explanation, based on previous FTW experience, is that the microbial biofilm growing in and around the BioHaven degraded the BPA. This could be confirmed by repeating the experiment and chemically analyzing for BPA.

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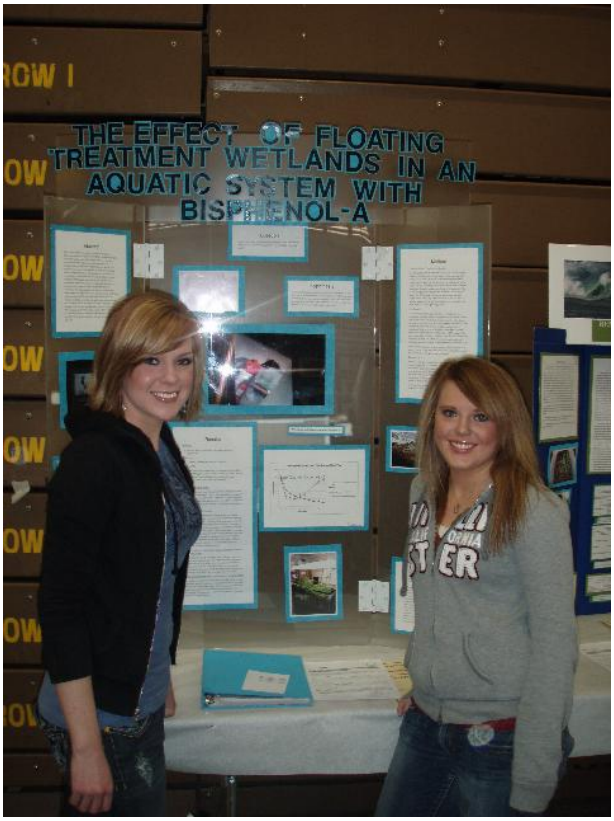

Students Juanita Mathews and Mykal Eden at the Billings Science Fair, March 2008

BioHavens used in Conditions 3 and 4

Close-up of BioHavens

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