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Progress Report

Brief Summary of Water Column and Sediment Toxicity Temporal Trends Analysis for the Westside Coalition from 2004 -2009

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Project Description

The objective of this pilot study was to conduct temporal trends analysis for water column and sediment toxicity data collected from the Westside Coalition from 2004 to 2009. Water column toxicity tests were conducted with the following test species: water flea, *Ceriodaphnia dubia*; green algae, *Selenastrum capricornutum*, and fathead minnow, *Pimephales promelas*. Sediment toxicity tests were conducted with the amphipod, *Hyalella azteca*. The following number of single species toxicity tests were conducted for the 6 year period: 891 water flea tests; 659 green algae tests; 536 fathead minnow tests and 170 amphipod tests. A total of 2,256 water column and sediment toxicity tests were conducted at 26 mainstem and tributary sites during the 6 year period.

Standard regression analysis with an arcsine transformation was used to determine temporal trends of annual % of toxicity tests that showed significant toxicity along with the associated r^2 and p values. If r^2 values (a measurement of the relationship of annual % toxicity tests showing statistically significant toxicity to each other) exceeded 0.25, the regression was considered to be meaningful in determining a trend. The p value – which measures the risk of being wrong – was interpreted in the content of the data set size. This data set is considered somewhat small for trends analysis because only six annual percent of toxicity test values were used in the regression analysis. Therefore, the strict use of a p value $\leq$ 0.05 (a common cutpoint typically used in environmental data analysis) to indicate a meaningful trend was not considered necessary. For these data sets, a $p \leq 0.10$ was considered meaningful if r^2 values exceeded 0.25.

Results

Water flea toxicity test results from all Westside sites in Figure 1 showed a significant decline ($p<0.10$) in toxicity from all sites from 2004 to 2009. Additional analysis was also conducted considering waterbody size (tributary and mainstem sites). Water flea toxicity data from only tributary sites in Figure 2 also showed a significant decline over time ($p<0.10$). Regression analysis of water flea toxicity from only mainstem sites was not statistically meaningful (Figure 3).

Green algae toxicity test results in Figure 4 showed a significant decline ($p<0.10$) in toxicity from all Westside sites from 2004 to 2009. A similar statistically significant declining trend in algae toxicity was also reported from all tributary sites (Figure 5). Regression analysis of algae toxicity from mainstem sites was not significant (Figure 6).

Regression analysis of fathead minnow toxicity test results from all Westside sites from 2004 to 2009 in Figure 7 suggested a significant declining trend but a p value could not be calculated due to unequal variance among data points. When the data from 2004 was removed (0% of toxicity tests showing toxicity) from the analysis a significant annual decline in fathead minnow toxicity was reported ($p < 0.05$) from 2005 to 2009 (Figure 8). Fathead minnow toxicity data from only tributary sites suggested a declining trend but a p value could not be calculated due to unequal variance among data points (Figure 9). However, when the 2004 data was removed because there was no reported toxicity from any test in that year, a statistically significant declining trend in toxicity was reported (Figure 10). An assessment of temporal trends in fathead minnow toxicity could not be calculated at mainstem sites because there was no significant toxicity in any year (Figure 11).

Regression results from annual *Hyalella* sediment toxicity tests for all sites suggested a slight increase in toxicity over time (Figure 12). However, these results were not statistically confirmed. Regression analysis of *Hyalella* toxicity at tributary and mainstem sites was not statistically significant (Figures 13 and 14).

A grand analysis of significant toxicity for all water column and sediment toxicity tests combined for all sites over all years in Figure 15 showed a statistically significant decline in toxicity ($p < 0.05$). A similar result – declining toxicity over time - was also reported for significant toxicity for the three water column toxicity tests combined over the 6 year period (Figure 16).

Summary

The results from this analysis showed the following:

- The percent of statistically significant water column toxicity test results from 891 water flea toxicity tests and 659 green algae toxicity tests were reported to significantly decline at Westside Coalition sites from 2004 to 2009.
- Regression analysis of fathead minnow toxicity test results from all Westside sites from 2004 to 2009 suggested a significant declining trend but a p value could not be calculated due to unequal variance among data points.
- Results from regression analysis of 170 *Hyalella* sediment toxicity tests conducted at all Westside Coalition sites annually from 2004 to 2009 did not show a statistically significant trend.
- A grand analysis of significant toxicity test results from 2,256 water column and sediment toxicity tests combined from all Westside Coalition sites from 2004 to 2009 showed a statistically significant temporal decline.

Figure 1. Annual percent of *Ceriodaphnia dubia* toxicity tests that showed significant toxicity at all Westside Coalition sites from 2004 to 2009 ($r^2 = 0.541$, $p = 0.096$).

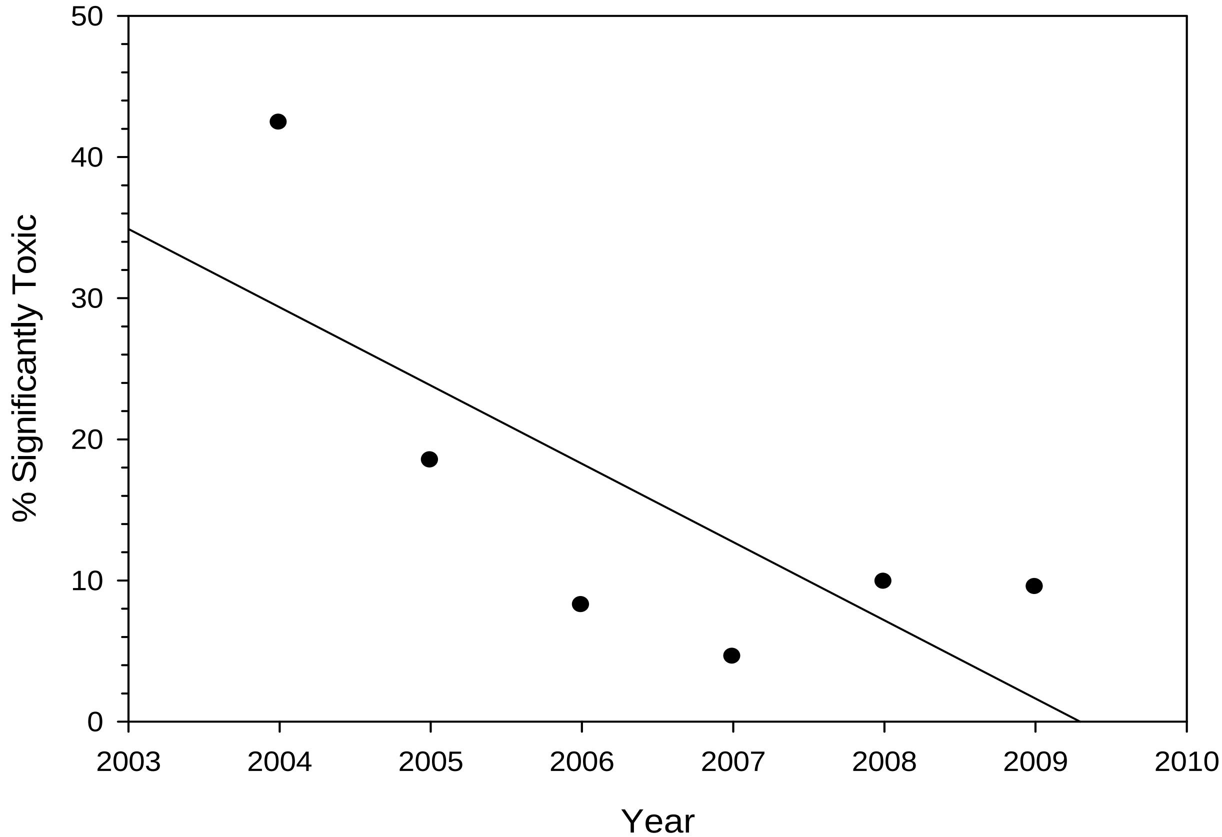

Figure 2. Annual percent of *Ceriodaphnia dubia* toxicity tests that showed significant toxicity at all Westside Coalition tributary sites from 2004 to 2009 (r^2 = 0.540, p = 0.096).

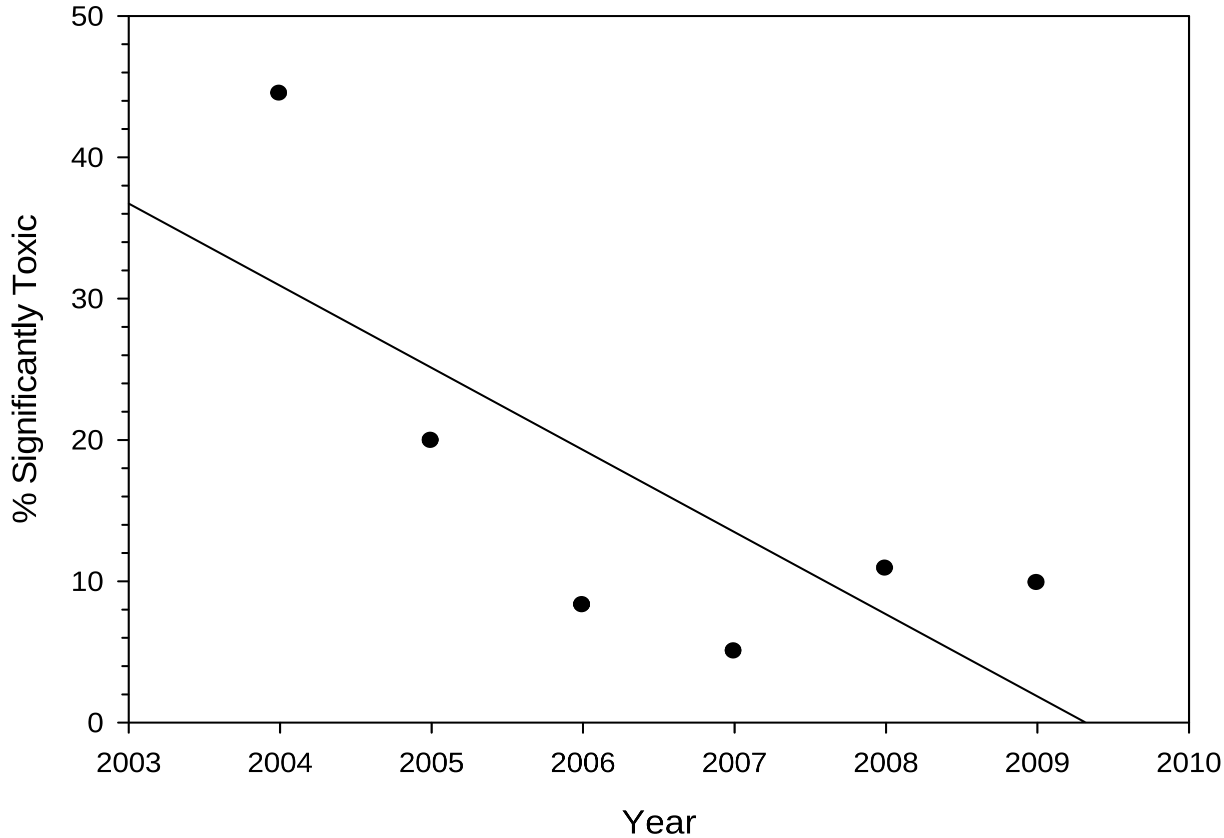

Figure 3. Annual percent of *Ceriodaphnia dubia* toxicity tests that showed significant toxicity at all Westside Coalition mainstem sites from 2004 to 2009 ($r^2 = 0.153$, $p = 0.444$).

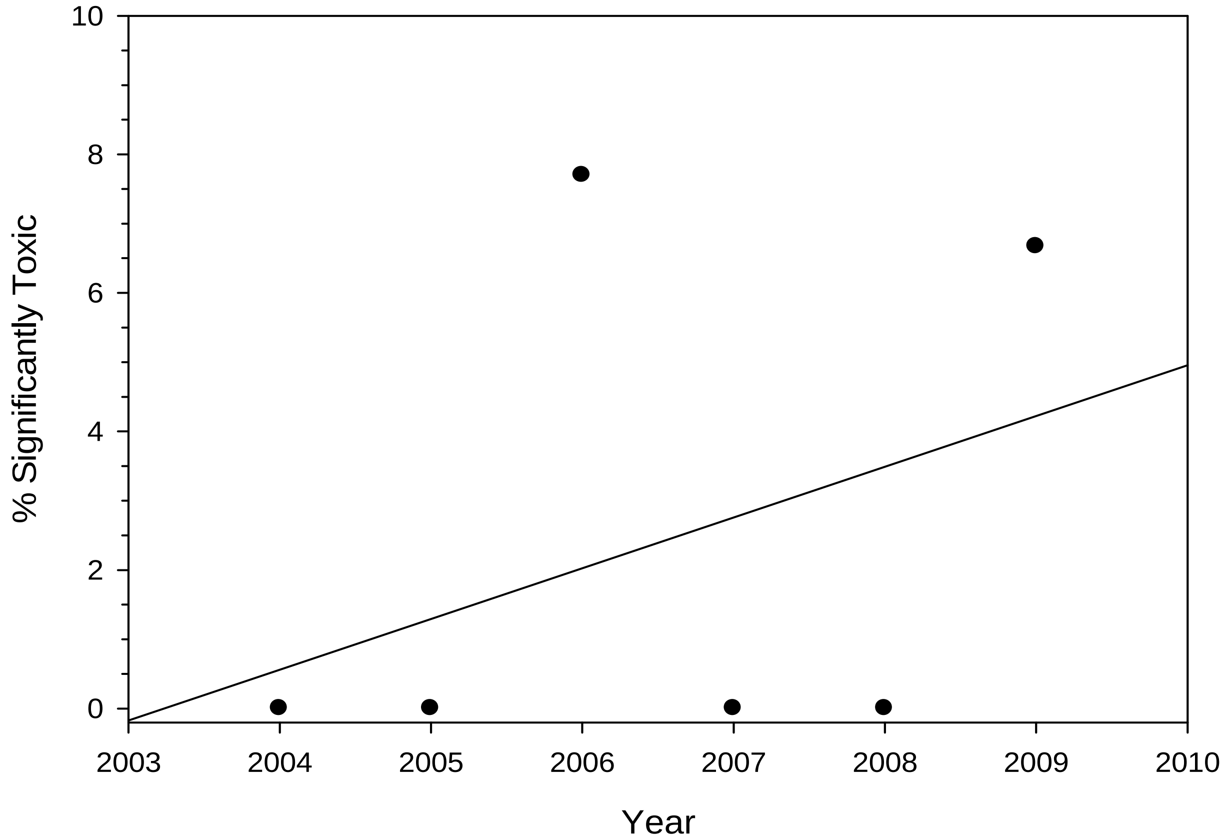

Figure 4. Annual percent of *Selenastrum capricornutum* toxicity tests that showed significant toxicity at all Westside Coalition sites from 2004 to 2009 (r^2 = 0.581, p = 0.078).

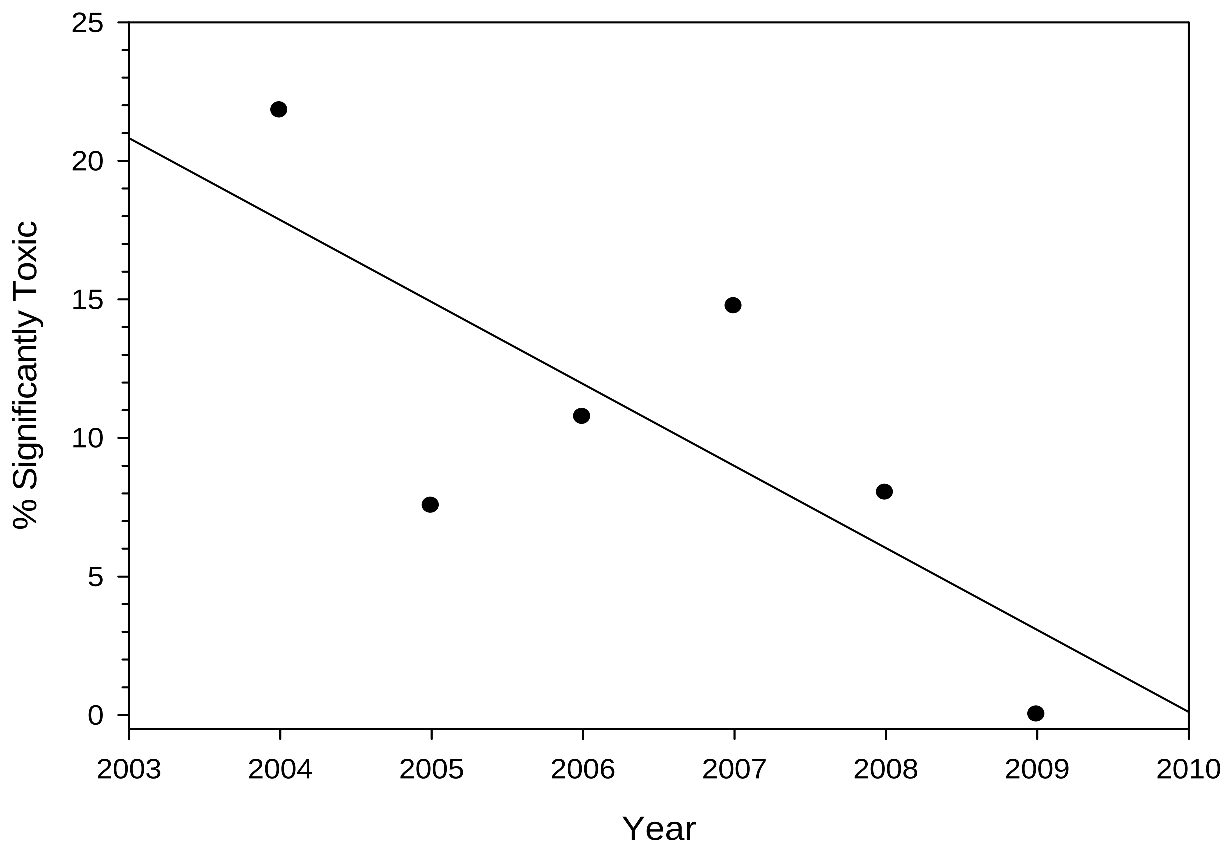

Figure 5. Annual percent of *Selenastrum capricornutum* toxicity tests that showed significant toxicity at all Westside Coalition tributary sites from 2004 to 2009 (r^2 = 0.609, p = 0.067).

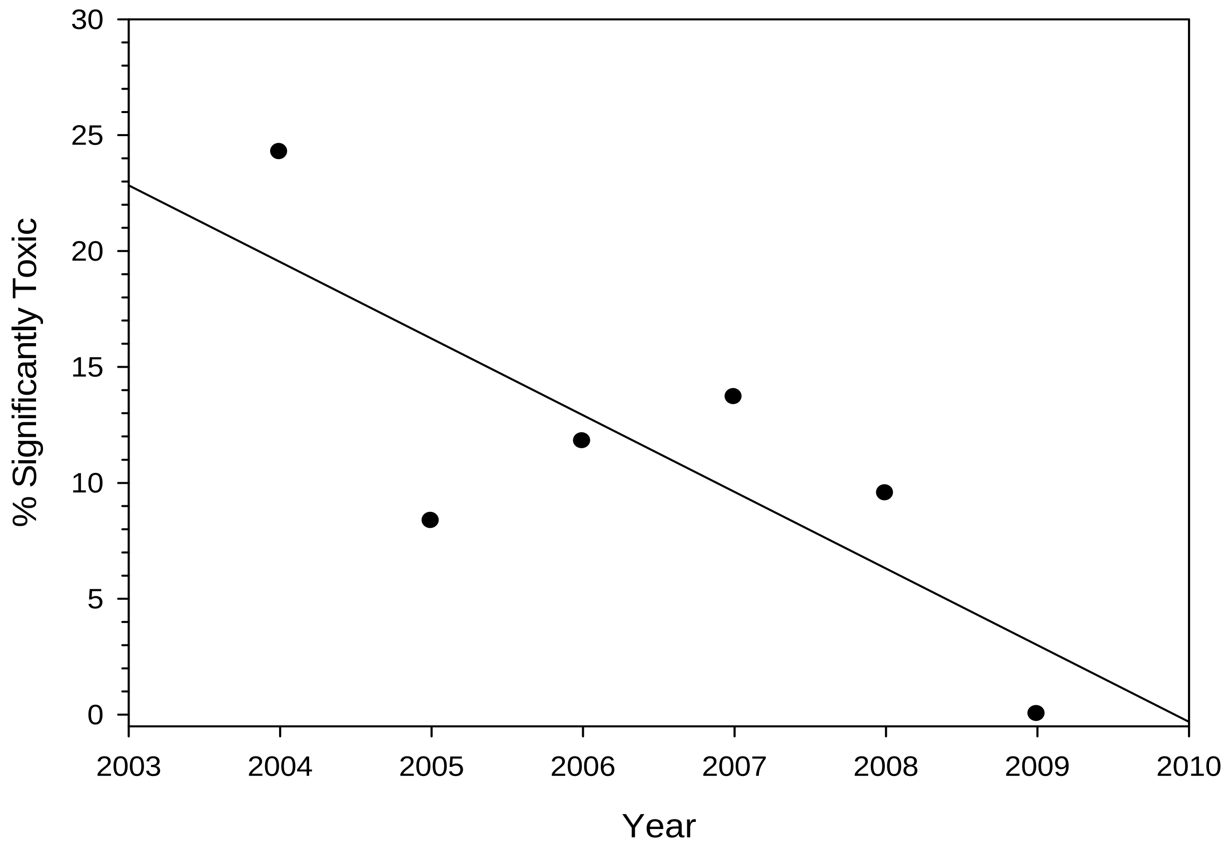

Figure 6. Annual percent of *Selenastrum capricornutum* toxicity tests that showed significant toxicity at all Westside Coalition mainstem sites from 2004 to 2009 ($r^2 = 0.051$, $p = 0.668$).

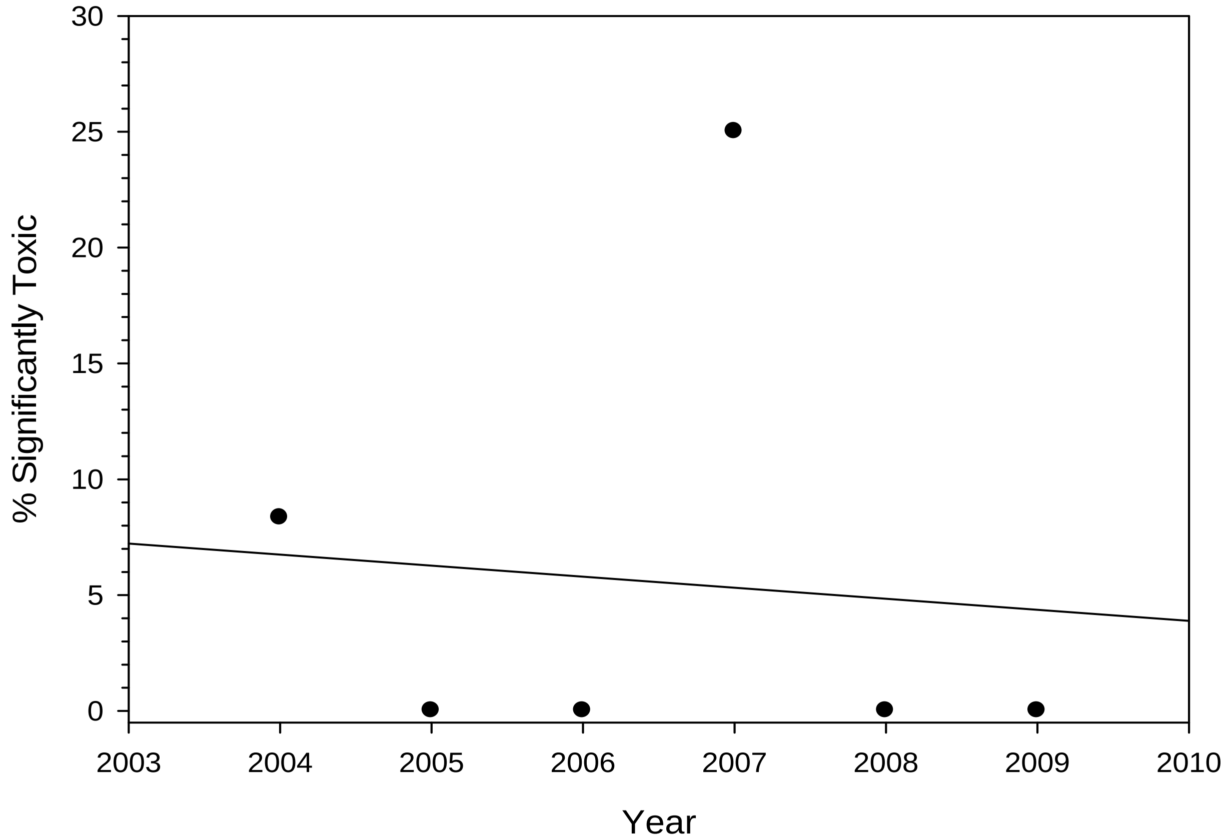

Figure 7. Annual percent of *Pimephales promelas* toxicity tests that showed significant toxicity at all Westside Coalition sites from 2004 to 2009 (r^2 = 0.133, p = NV). The p-value was not valid (NV) due to unequal variance among the data points.

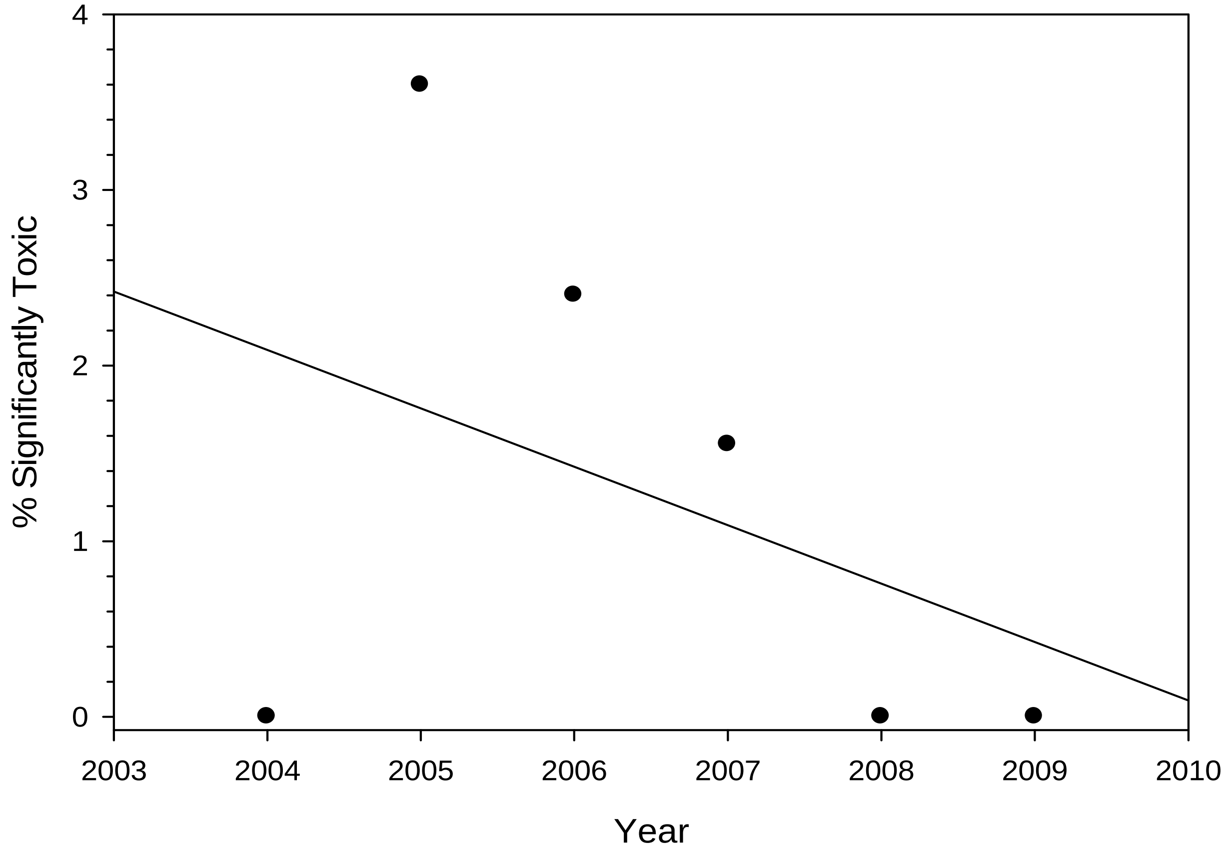

Figure 8. Annual percent of *Pimephales promelas* toxicity tests that showed significant toxicity at all Westside Coalition sites from 2004 to 2009 ($r^2 = 0.908$, $p = 0.012$). A possible outlier (year 2004 data where no toxicity was reported) was left out of the regression.

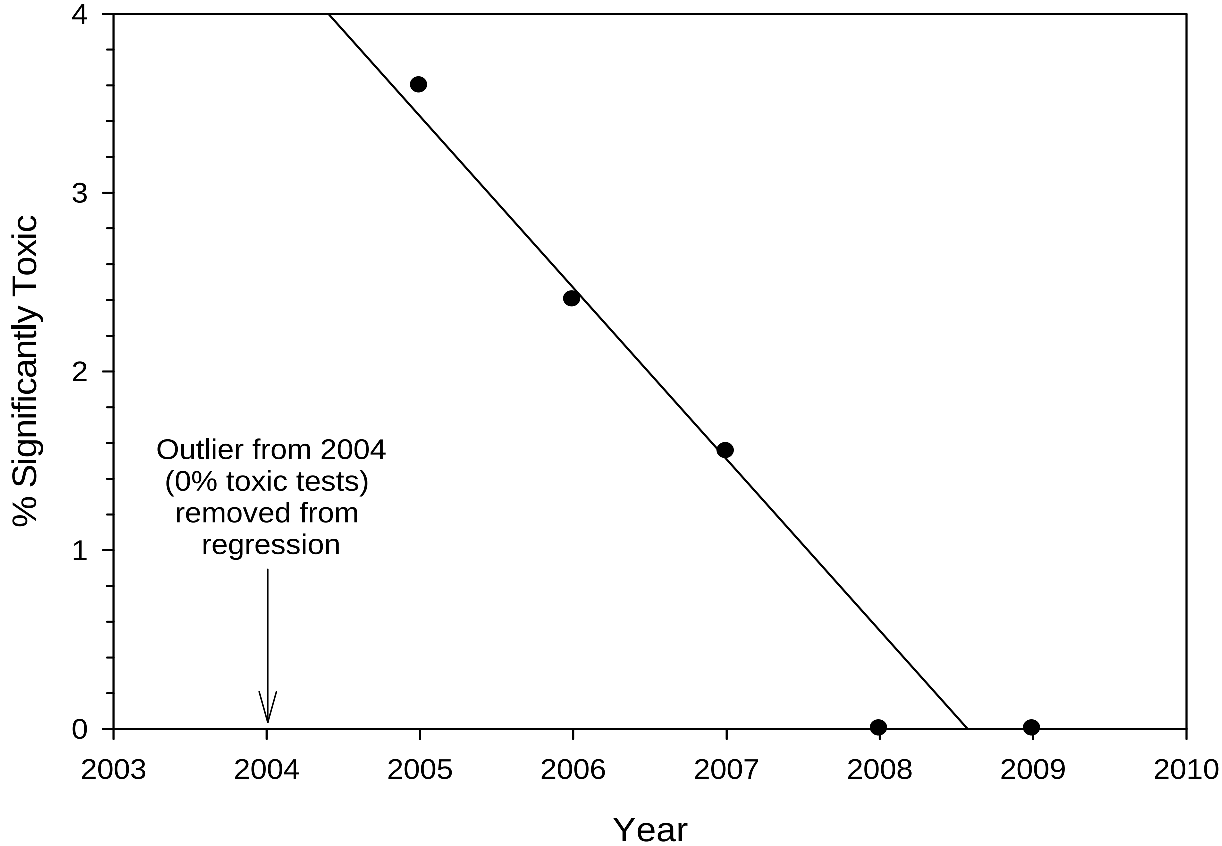

Figure 9. Annual percent of *Pimephales promelas* toxicity tests that showed significant toxicity at all Westside Coalition tributary sites from 2004 to 2009 (r^2 = 0.133, p = NV). The p-value was not valid (NV) due to unequal variance among the data points.

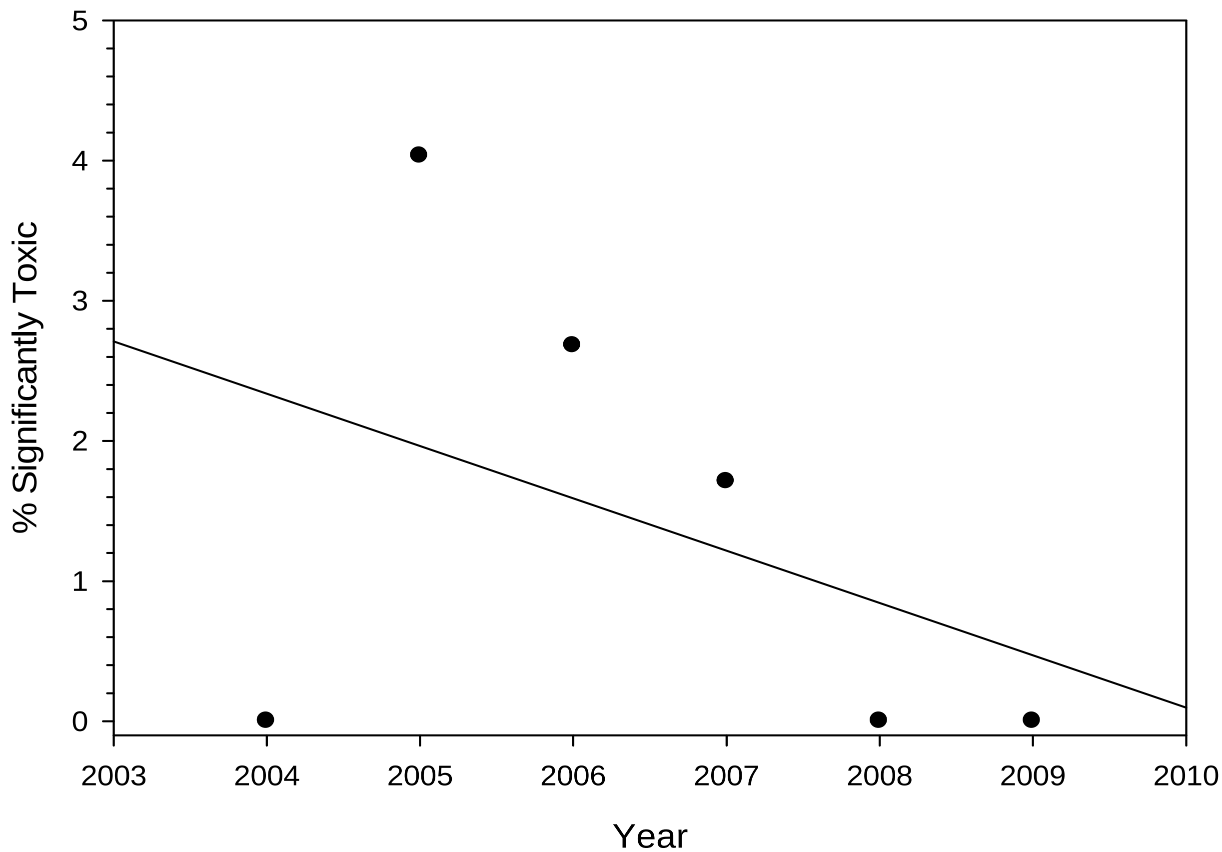

Figure 10. Annual percent of *Pimephales promelas* toxicity tests that showed significant toxicity at all Westside Coalition tributary sites from 2004 to 2009 (r^2 = 0.910, p = 0.012). A possible outlier (year 2004 data where no toxicity was reported) was left out of the regression.

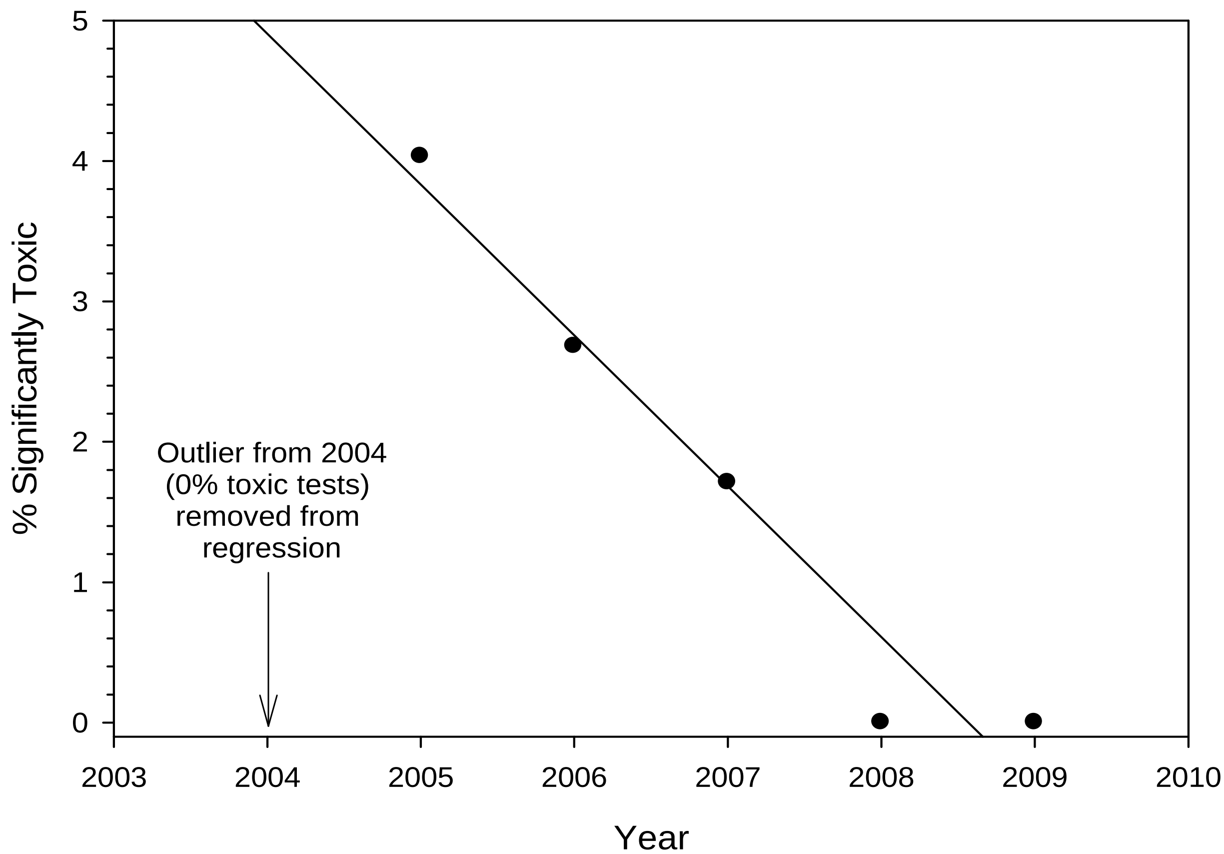

Figure 11. Annual percent of *Pimephales promelas* toxicity tests that showed significant toxicity at all Westside Coalition mainstem sites from 2004 to 2009 (r^2 = NV, p = NV). The r^2 and p-values were not valid (NV) due to the total lack of variance.

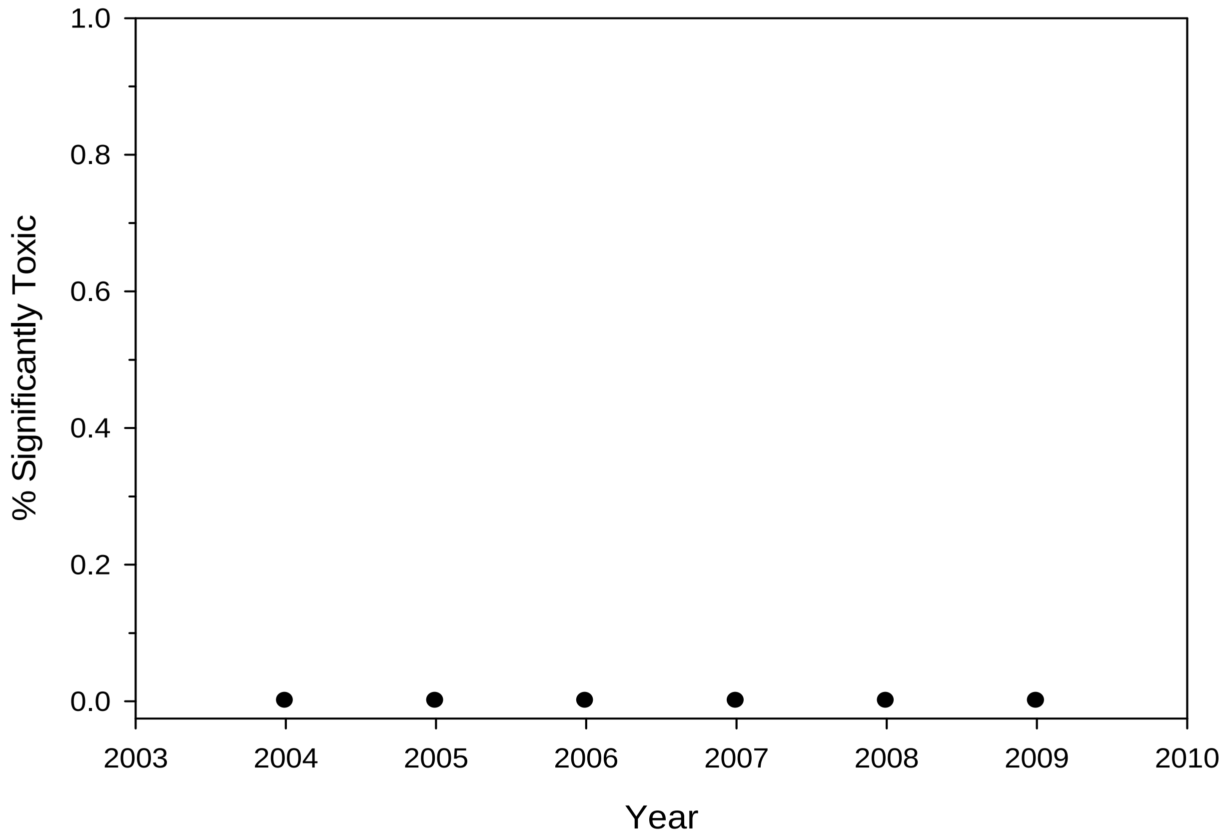

Figure 12. Annual percent of *Hyalella azteca* toxicity tests that showed significant toxicity at all Westside Coalition sites from 2004 to 2009 (r^2 = 0.453, p = 0.143).

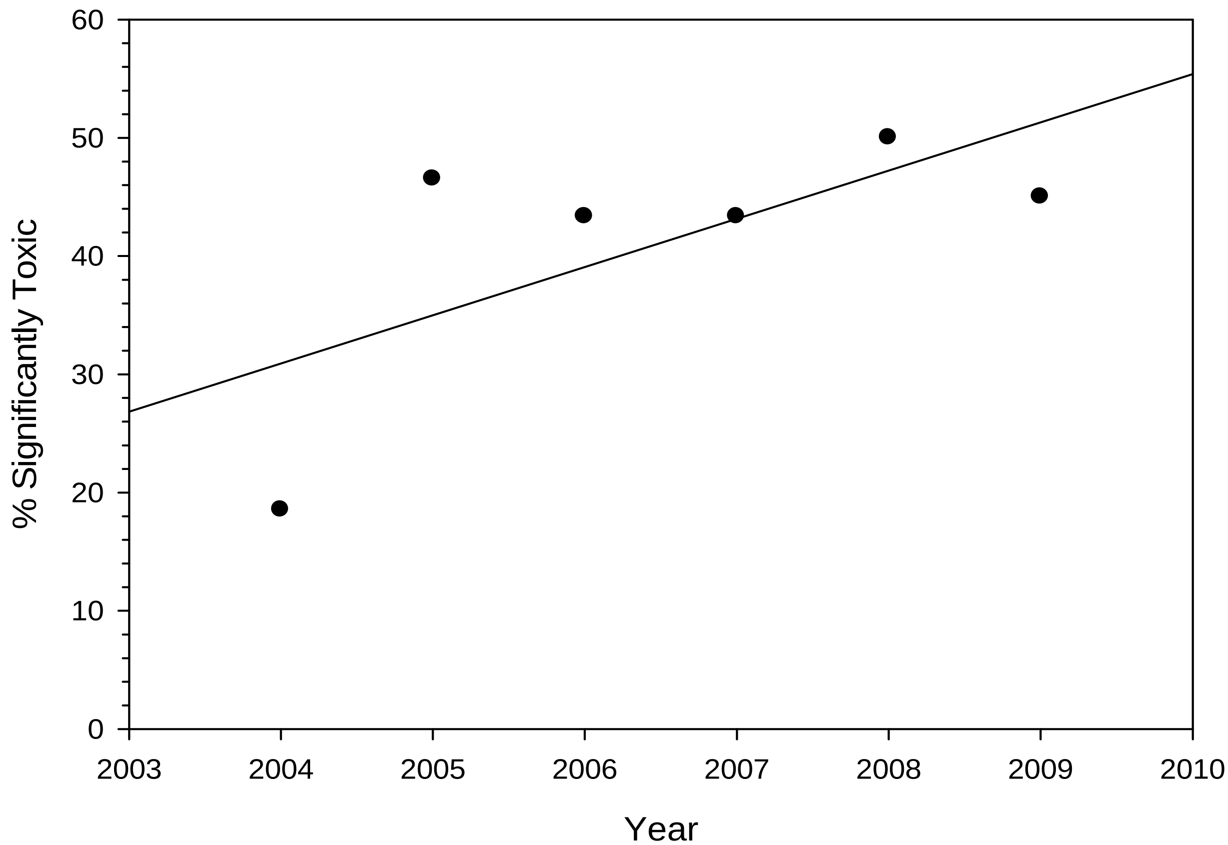

Figure 13. Annual percent of *Hyalella azteca* toxicity tests that showed significant toxicity at all Westside Coalition tributary sites from 2004 to 2009 (r^2 = 0.337, p = 0.227).

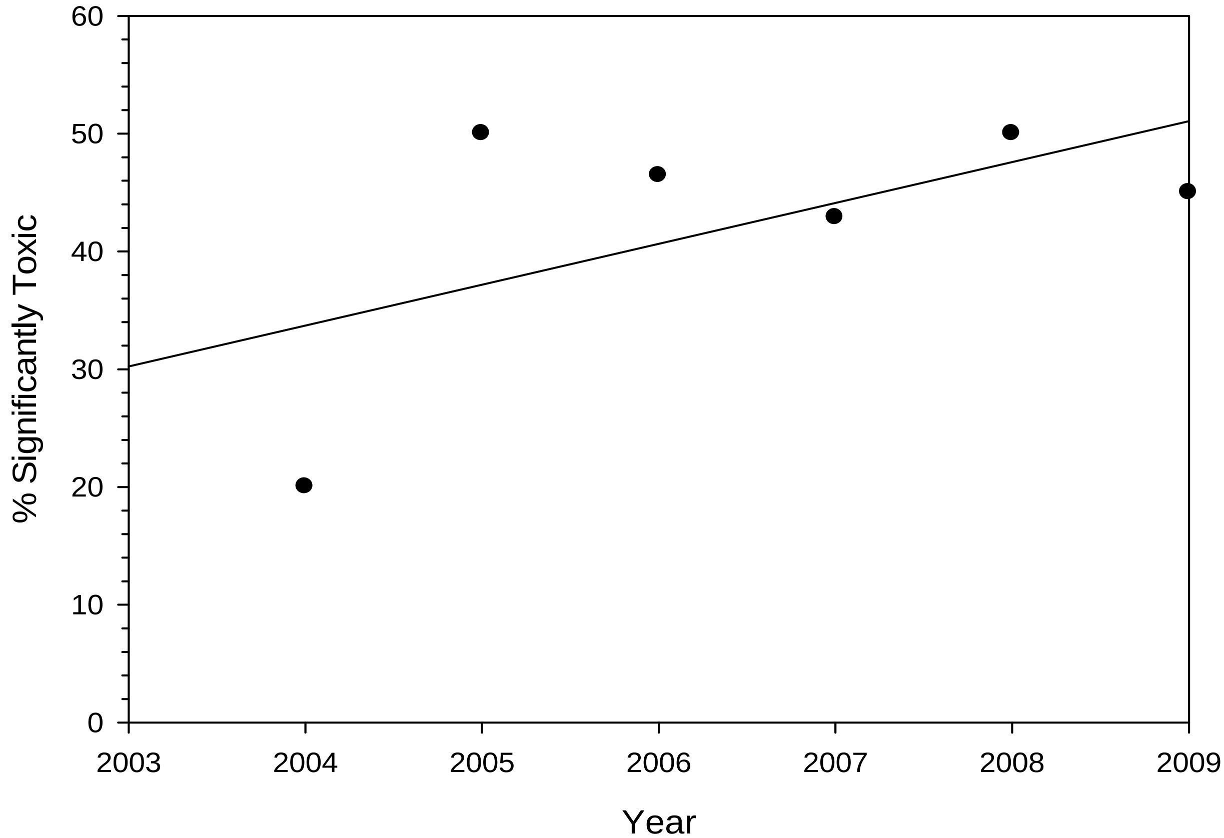

Figure 14. Annual percent of *Hyalella azteca* toxicity tests that showed significant toxicity at all Westside Coalition mainstem sites from 2004 to 2009 (r^2 = 0.600, p = NV). The p-value was not valid (NV) due to unequal variance among the data points.

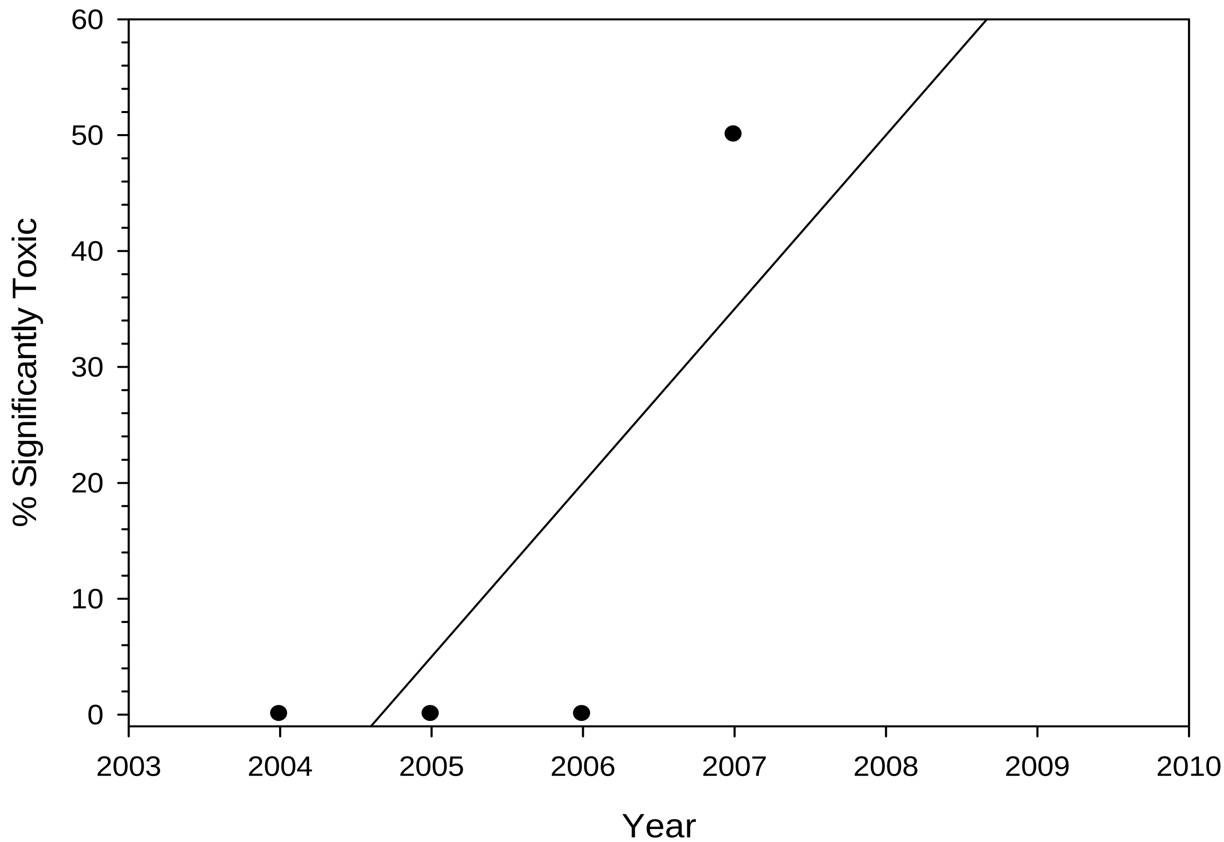

Figure 15. Annual percent of toxicity tests for all water column and sediment test species combined that showed significant toxicity at all Westside Coalition sites from 2004 to 2009 (r^2 = 0.663, p = 0.049).

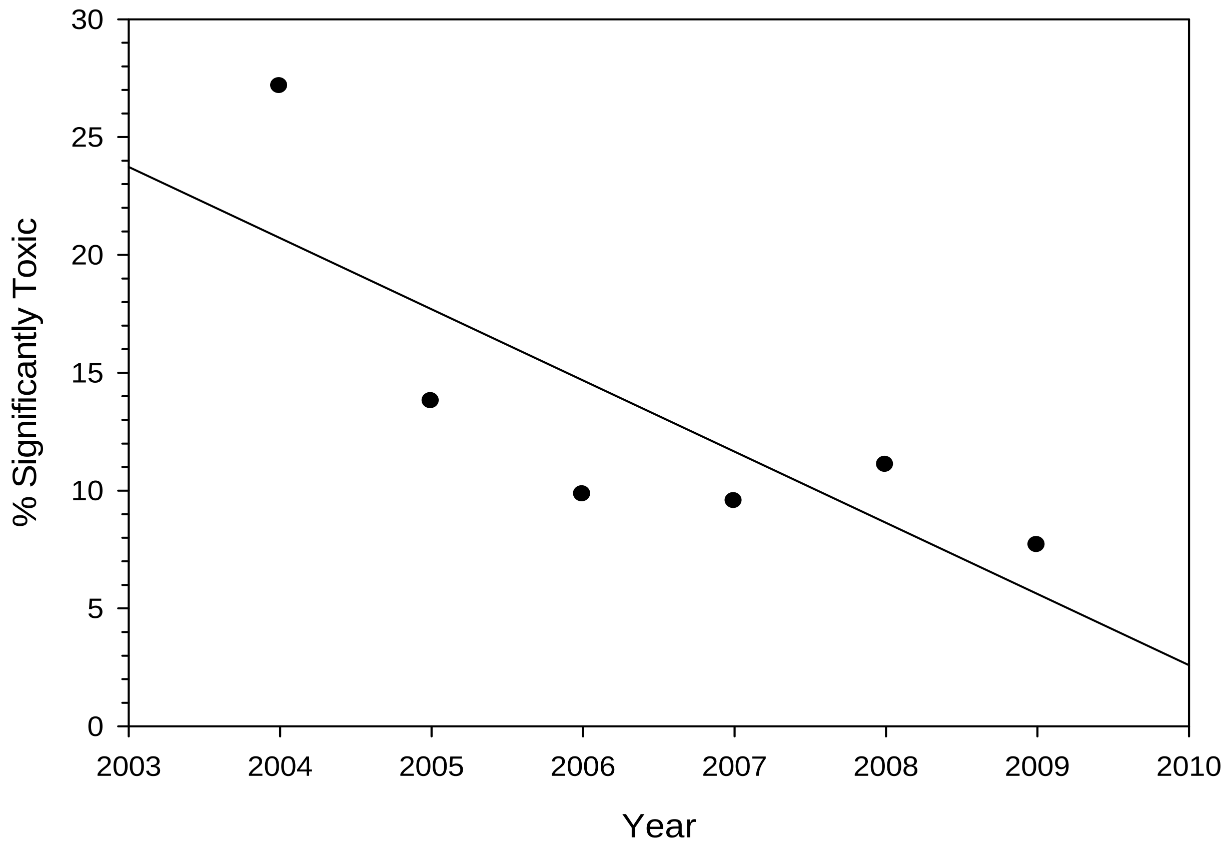

Figure 16. Annual percent of toxicity tests for all three water column test species that showed significant toxicity at all Westside Coalition sites from 2004 to 2009 ($r^2 = 0.664$, $p = 0.048$).