

Mutagenicity of Water Samples from Local Streams Impacted by Coal Processing Facilities

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Abstract

The coal mining industry provides most of our nation's energy for generating electricity. Pennsylvania is known for its coal facilities and Greene County is a location that has been known for its coal processing facilities and mining facilities for over a century. This locality is also known for its high quality streams for fishing and recreation. This research investigation was conducted to determine whether 10-Mile Creek and a surrounding tributary are being potentially impacted from coal by-products released to the surface waters. Although surrounding streams are routinely monitored using standard water quality tests, actual biological effects of these coal by-products in natural aquatic systems are largely unknown in this locality. More specifically, the presence of contaminants that may cause mutations (i.e., genetic damage) in living organisms has not been tested. The presence of mutagenic and potential carcinogenic by-products resulting from the production, processing and burning of coal are well established (Environmental Impacts of Coal)*. We employed a well-established biological assay, The Ames Mutagenicity Test, to determine the mutagenic potential of water samples taken both upstream and downstream from 2 coal processing facilities located in Waynesburg, PA. This test is a screening tool used to evaluate the mutagenic activity of TA98 *Salmonella typhimurium* bacteria following laboratory exposure to water samples. An S9 rat liver enzyme was used in combination with half of the test samples in order to mimic how a mammalian physiological system would react to exposure to these compounds. The objective of this study was to determine whether the surface waters in Greene County, which may come in contact with coal processing facility waste, contain mutagenic compounds. The positive results of the Ames Assay suggest the presence of mutagenic compounds in the surface water samples taken below 2 coal processing facilities in Waynesburg. The Ames Test is a tool that can be used in the future to continue monitoring the mutagenic potential of local surface and groundwaters which are suspected to be impacted by anthropogenic activities.

**Environmental Impacts of Coal." - SourceWatch. N.p., n.d. Web. 13 Apr. 2013.

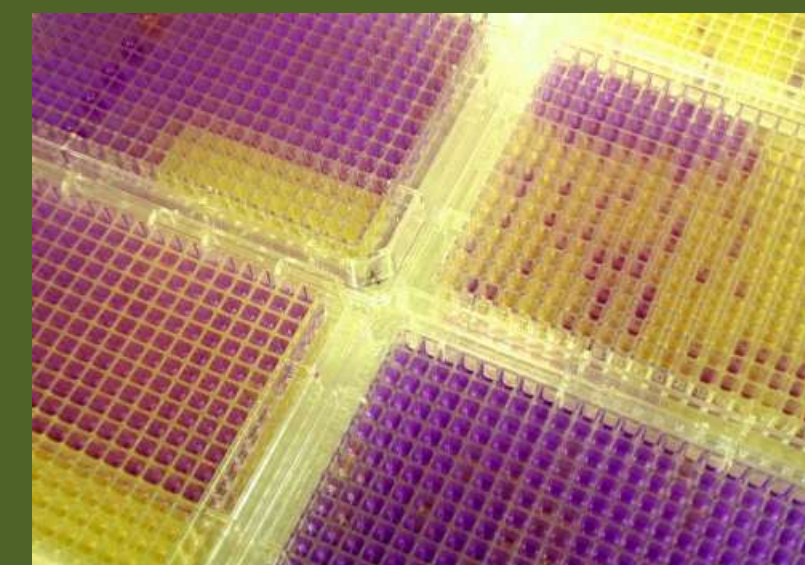
Introduction

- The coal industry provides more than half of the nation's energy.
- Pennsylvania is widely known for its coal facilities and Greene County is affected by coal mining economically and environmentally
- Coal mining requires large quantities of water. The processing of coal allows water to come in contact with many pollutants such as heavy metals which can be environmental toxins.
- The presence of these toxins in the water could cause mutagenic and possibly carcinogenic effects to organisms that come in contact with the water.



Materials & Methods

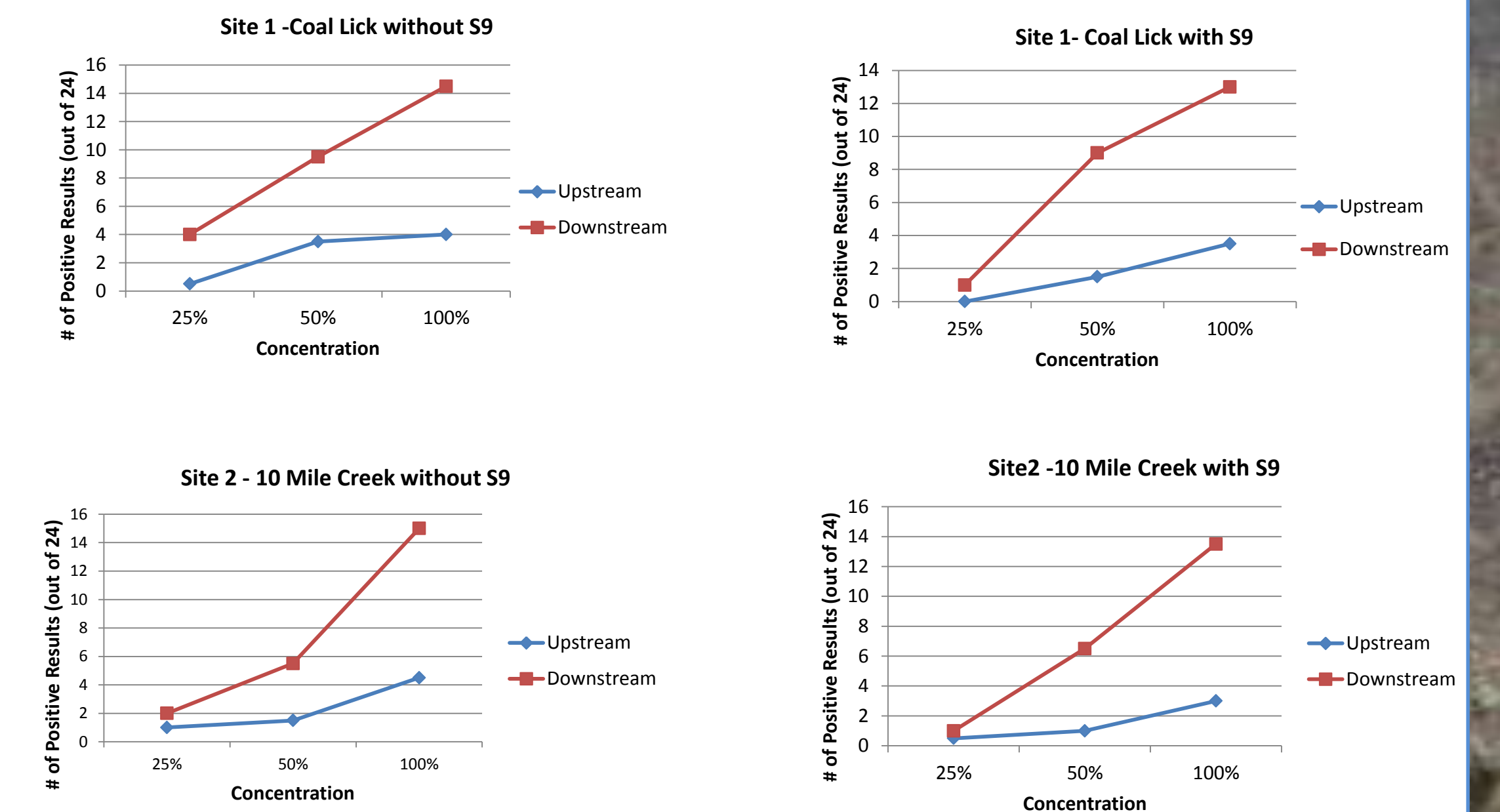
- Water Samples were collected from two local sites in Greene County both upstream and downstream from a local coal processing facility.
- The sites are Coal Lick and 10 Mile Creek which are located near different portals of the coal processing facility.
- The Ames Test is a screening tool used to monitor potential biological effects.
- The Ames Test was purchased from BioAntares, a company that specializes in quality toxicology.
- This test uses different strains of *Salmonella typhimurium*, for this test we used the TA98 strain.
- An S9 rat liver enzyme was also present in the assay. Test results were compared with and without the S9. The S9 mimics a mammalian body's physiological response to mutagens.
- Different strains determine different mutations. TA98 specifically targets frameshift mutations.
- Heavy metals have been known to cause frameshift mutations.
- The Ames Test results are determined by counting the number of positive results present in the plate wells as well as a statistical analysis.
- A positive result is when the purple Indicator Medium changes to a yellow color as seen in the example figure below.



Acknowledgments

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Results



Conclusion

Positive test results were recorded and a statistical analysis was conducted. A significant P-value of ≤ 0.05 was reached for each analysis. Each chart in the results section shows the three different concentrations used and the number of positive results reached comparing the Upstream and Downstream for each site. The charts also can be compared side by side to see the different effect that was caused by the presence or absence of the S9 rat liver enzyme. This is important because the S9 rat liver enzyme mimics a mammalian body's response to exposure to a mutagen. These results show a negative biological effect taking place at these locations. The demonstrations of a mutagenic effect in living organisms is a potential precursor to the formation of cancer. A significant number of by-products resulting from the use of coal which are carcinogenic include heavy metals and polycyclic aromatic hydrocarbons (PAHs), both of which have been found at many locations in contaminated surface waters near coal processing facilities and could subsequently be present in our locality. The Ames test is a potential screening tool that could be used to monitor these mutagenic effects in the future.