Bioaccumulation of Heavy Metals in *Schoenoplectus californicus* of Lake Waco Wetlands

Corbin Goerlich, Don Gray, Nikesh Patel. Baylor University Waco, TX 76798

Abstract

The purpose of this project was to detect the levels of heavy metal bioaccumulation in the Lake Waco Wetlands. The method in which we carried out this task was by dispersive sampling of an organism susceptible to heavy metal accumulation. The plant we utilized for this project was *Schoenoplectus californicus* (Bulrush) because of its prevalence and continuity in the wetlands and its tendency to accumulate heavy metals in its roots, over time, when heavy metals are prevalent in its water source (Arreghini et al. 2006). This research surveyed the efficiency of the wetlands in filtering out heavy metal pollutants from the water in the North Bosque River. After obtaining the *S. californicus* samples, they were dried and prepared for testing. In addition, water samples were taken in these areas for comparative data and computation of the concentration of heavy metals within North Bosque River's water. Moreover, this was done in order to find a probable source of heavy metals within the wetlands (Maiti et al. 2008). The hypothesis was that the results would reveal a high concentration of heavy metals from the North Bosque River within the rhizomes of *S. californicus* relative to the concentration of heavy metals within the water, indicating a presence of bioaccumulation of heavy metals within Lake Waco Wetlands' *S. californicus*. This preliminary study could lead to further studies in bioaccumulation and the feasibility of phytoremediation.

Introduction

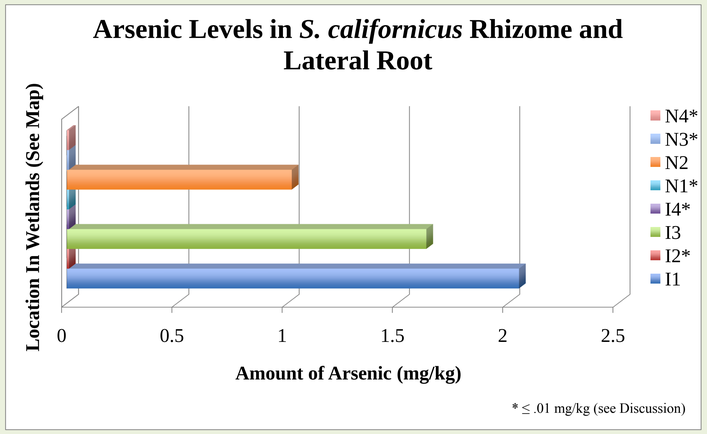
The amount of heavy metal bioaccumulation occurring within Lake Waco Wetlands was not known, but bioaccumulation has been observed in other ecosystems containing plants from the genus *Schoenoplectus* (Arreghini et al. 2006). There was reason to believe that there was a prevalence of heavy metals in the North Bosque River and Waco Wetlands due to the prevalence of heavy metals in the soil when the wetlands was drained in 2006 (Gray et al. 2006). The heavy metals lead and arsenic were chosen due to the Agency for Toxic Substances and Disease Registry ranking them 1st and 3rd respectively in severity of their toxicity and prevalence in toxic waste sites (Rai 2008). The sample sites were chosen in close proximity to the infill and outflow of the wetlands (fig. 1) to observe the difference in water quality regarding heavy metals as it moved through Lake Waco Wetlands. By surveying this, data from both the Lake Waco Wetlands water and *S. californicus* rhizome could potentially show the amount of heavy metal bioaccumulation occurring as water flows through the wetlands.

Materials and Methods

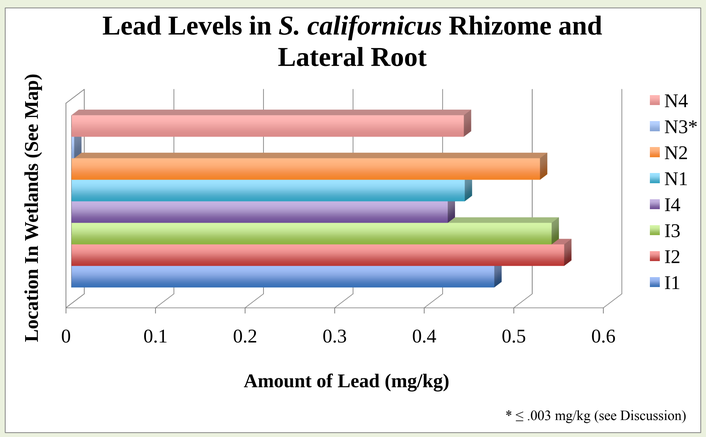
Four dispersive plant locations that consisted of both water and plant samples were surveyed in both the in-fall and the last cell of the wetlands. From these locations, plants of consistent size were sampled, and water samples from each site were collected. The root masses were separated, cleaned, and gravimetrically measured to approximately 20 grams that consisted of lateral root and rhizome. The water was collected in 250 milliliter bottles and the temperature of the water and the time of day were also noted. The samples were packaged, refrigerated, and then sent to a certified independent laboratory for analysis using an Plasma-Atomic Emission Spectrometer (AES).

Results

The data (graphs 1 and 2) showed that there is, on average, more than 184 times the level of arsenic, and more than 164 times the level of lead in the root masses of the plants located in the inlet, compared to the maximum level of arsenic and lead that could have been detected in the wetland water by an AES (data showed that there were undetectable amounts of arsenic and lead within the water; see discussion). The outlet shows that there is bioaccumulation occurring as well, but not at the rate or severity of the inlet.



Graph 1



Graph 2

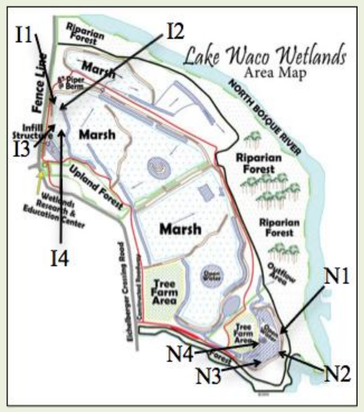


Figure 1

Weighing, Cleaning, and Packaging Rhizomes with Lateral Roots

Discussion and Conclusion

Due to the fact that the AES can only detect concentrations of 0.01 mg/l of arsenic, and 0.003 mg/l of lead in a given sample, the resulting data can only definitively indicate the minimum proportion of heavy metal concentration in *S. californicus* rhizome to water (bioaccumulation). In reality, the level of bioaccumulation may be higher. This indicates that the *S. californicus* is absorbing the metals, but does not indicates that *S. californicus* is sufficiently remediating heavy metals from in the water of Lake Waco Wetlands. Although there seems to be a decreasing trend of bioaccumulation with respect to the metals surveyed from the infill to the outflow, this is a preliminary study that has lead to many questions that can be answered by further inquiry. This includes using more sophisticated instrumentation to detect trace amounts of heavy metals within the water, testing the soil of the wetlands with more accurate instrumentation than what was used by Don Gray in his study in 2006, and controlling the age of the plants we survey. By doing this, further investigation can potentially prove what this study has reasoned: bioaccumulation is a result of small amounts of heavy metals from the water of Lake Waco Wetlands that accumulate in the substrate of which some aquatic plants reside and ultimately become stored in the rhizome of these plants.

Gathering an *S. Californicus* Plant

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