

Heavy Metal Snails: Arsenic Exposure and Bioaccumulation in Chinese Mystery Snails (CMS)

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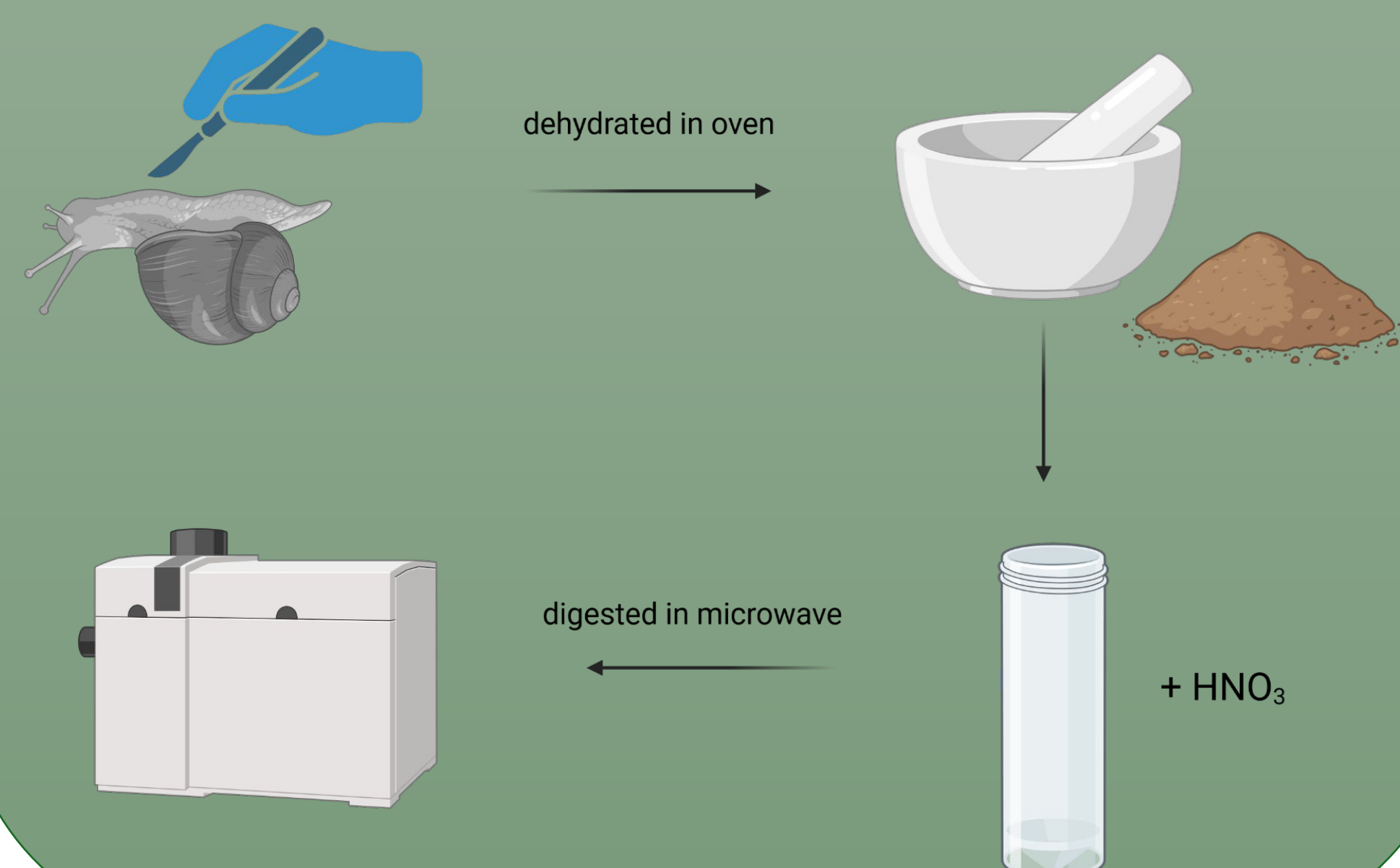
Background

The ARSARCO copper smelter in Tacoma, WA was destroyed in 1993 after operating for ~100 years, the emissions caused arsenic to leak into South Puget Sound lowlands. Shallow lakes with As-contaminated sediment can release As into the water and contaminate primary consumers, such as Chinese Mystery Snails (CMS). In this study, we investigated the immune response to acute As exposure in juvenile CMS. We hypothesized that arsenic exposure would lead to higher homocysteine counts in the hemolymph as a result of immune response and elevated As levels in tissue samples



Methods

- Exposed CMS to 20 ppm concentration of arsenic (As) and checked twice a week to count hemocytes (figure 2)
- Sacrificed them around week 4 to do ICP-MS and analyze the concentration of As found in the tissue.



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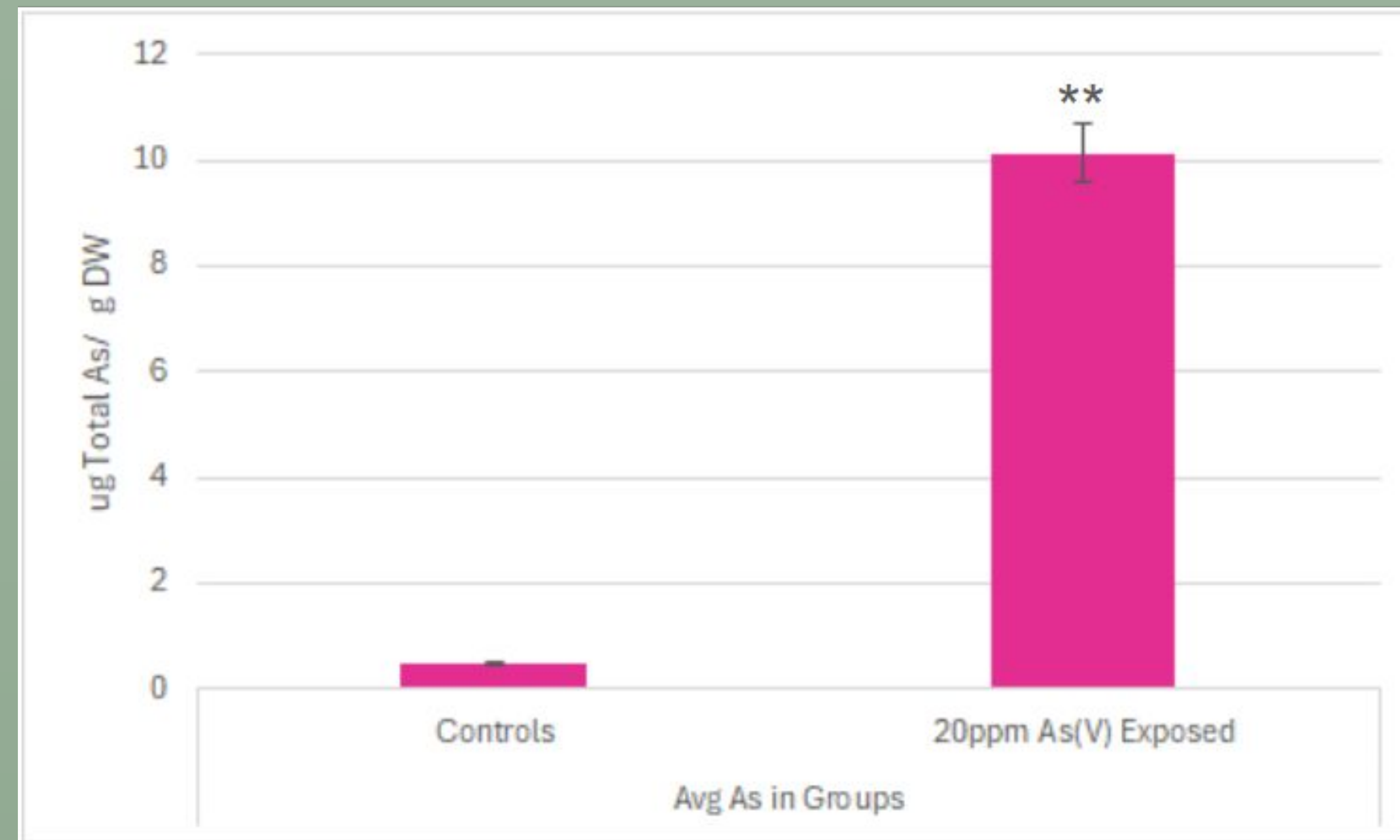


Figure 1. Arsenic bioaccumulates in exposed Chinese mystery snails. DW = dry weight. Each exposure group was two jars each containing four lab-acclimated Chinese mystery snails (*C. chinensis*). Lab water-based exposure ran over a time interval of 9 days. Error bars represent +/- standard error (Controls Standard Error = 0.0032, Exposed Standard Error=0.54). ANOVA F-crit= 4.6001, $**p < 0.001$, indicating results are significantly variable between control and exposed groups.

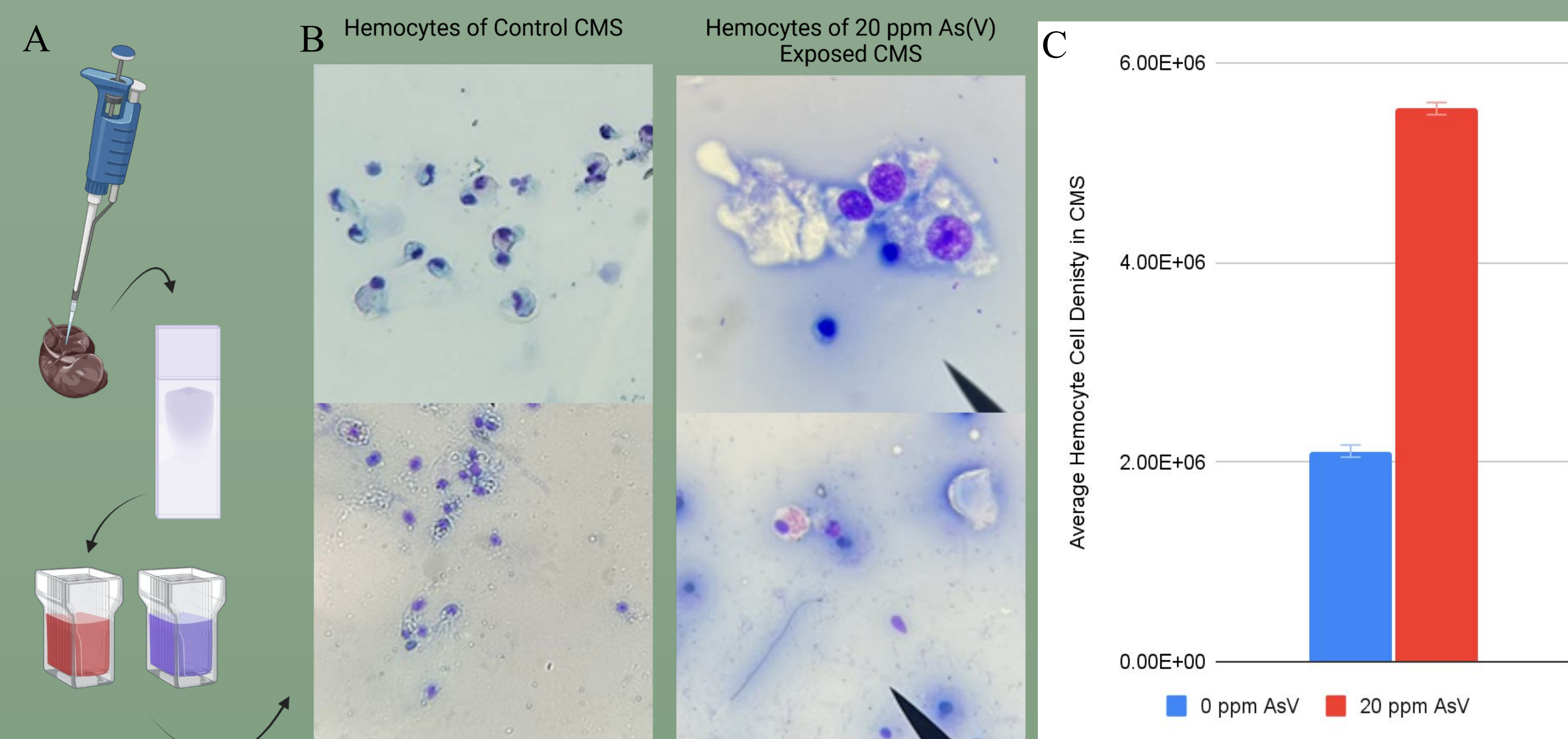


Figure 2. Hemocyte cell density increases with arsenic exposure. A) Hemocytes shown were collected from deceased snails on day 9. Controls (left) were in dechlorinated water for the duration of exposure. Exposed (right) were in dechlorinated water with 20 ppm As(V). Hemolymph was collected from sacrificed snails on day 9. Each hemolymph draw was mixed 1:1 with anticoagulant. Smears were stained using Eosin and Methylene Blue counterstain. B) Hemocyte appearance in stained blood smear at 400x magnification. C) Exposed snails had approximately 3x higher cell densities than controls. Created using Biorender.

Results

- Significantly higher hemocyte counts in the exposed group compared to the control group ($p\text{-value} < 0.05$)
- Significantly higher concentration of arsenic in the tissues of the As exposed group compared to the control group ($p\text{-value} < 0.001$).
- Amount of arsenic in tissue samples were higher than those observed in snails from lake Killarney

Conclusions and Next Steps

- Possible connection between arsenic exposure and inflammation
- Suggests hemocyte production as a biomarker for arsenic induced immune response
- Does an already compromised immune system lead to further vulnerability to arsenic?
- Are there connections between worsening inflammation and arsenic exposure disrupting microbiota compositions?
- Do these results hold true for chronic exposure?
- How do results differ in field collected snails vs. lab conditions?

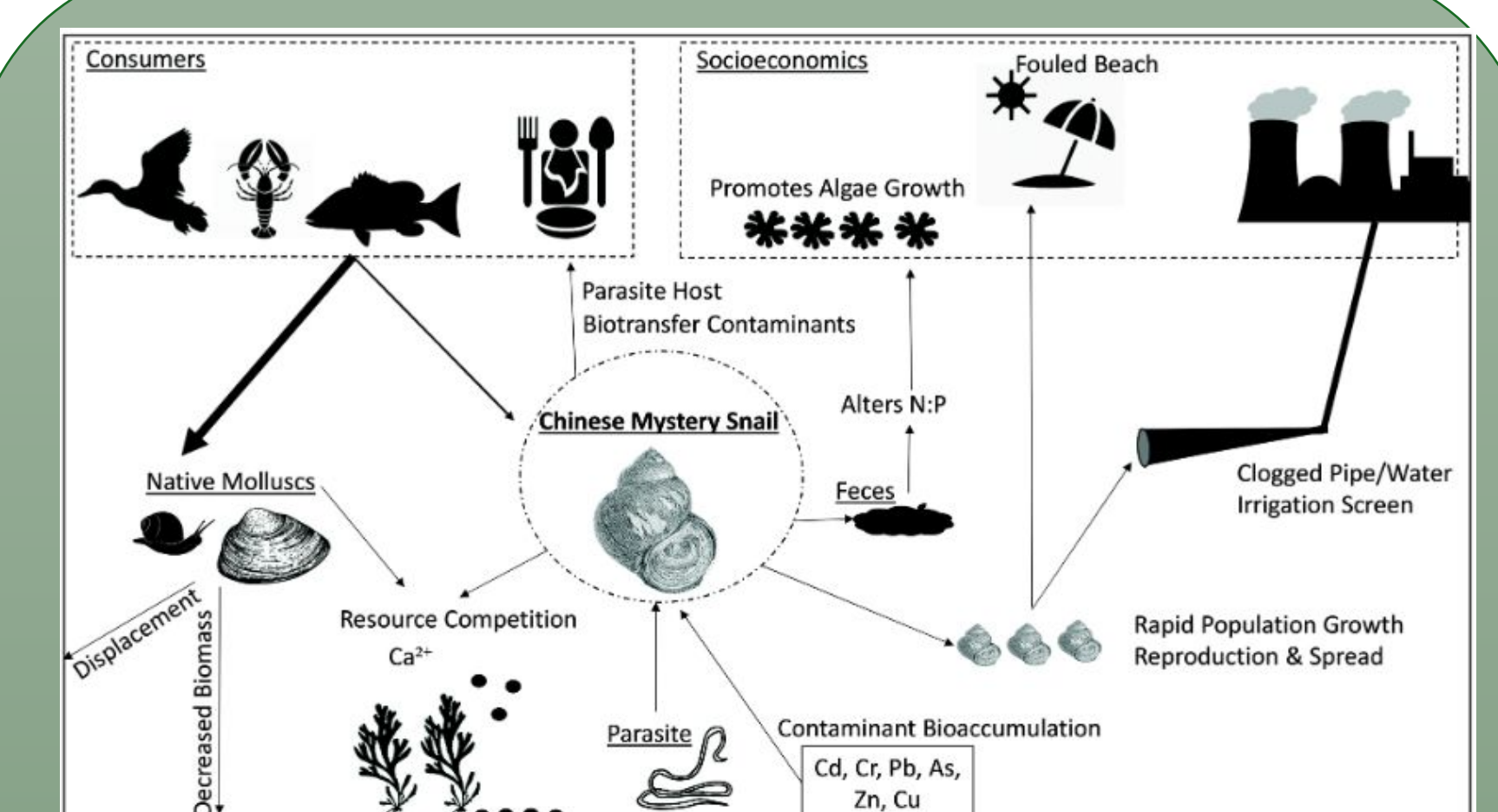


Figure 3. CMS interaction with local ecosystems in North America to show how As accumulation could transfer throughout ecosystem (Hull et. al 2023).