

Arsenic Exposure and Bioaccumulation in Chinese Mystery Snails and Developing Embryos Suggest Maternal Brood Transfer



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Introduction

- Arsenic from the legacy ASARCO copper smelter in Ruston, WA, presents an ecological threat to aquatic ecosystems and their resident organisms, including Chinese Mystery Snails.
- Lake Killarney, a small lake in Federal Way, WA, has one of the highest arsenic contamination concentrations but hosts a lot of life.
- Arsenic binds to sediments and accumulates in the tissues of Chinese Mystery Snails.
- Female Chinese Mystery Snails are viviparous (give birth to live babies) and carry their developing young (broods) in their brood pouch.
- Hypothesis: If Chinese Mystery Snail females transfer arsenic to their brood parturition, then broods will accumulate arsenic within the brood pouch.

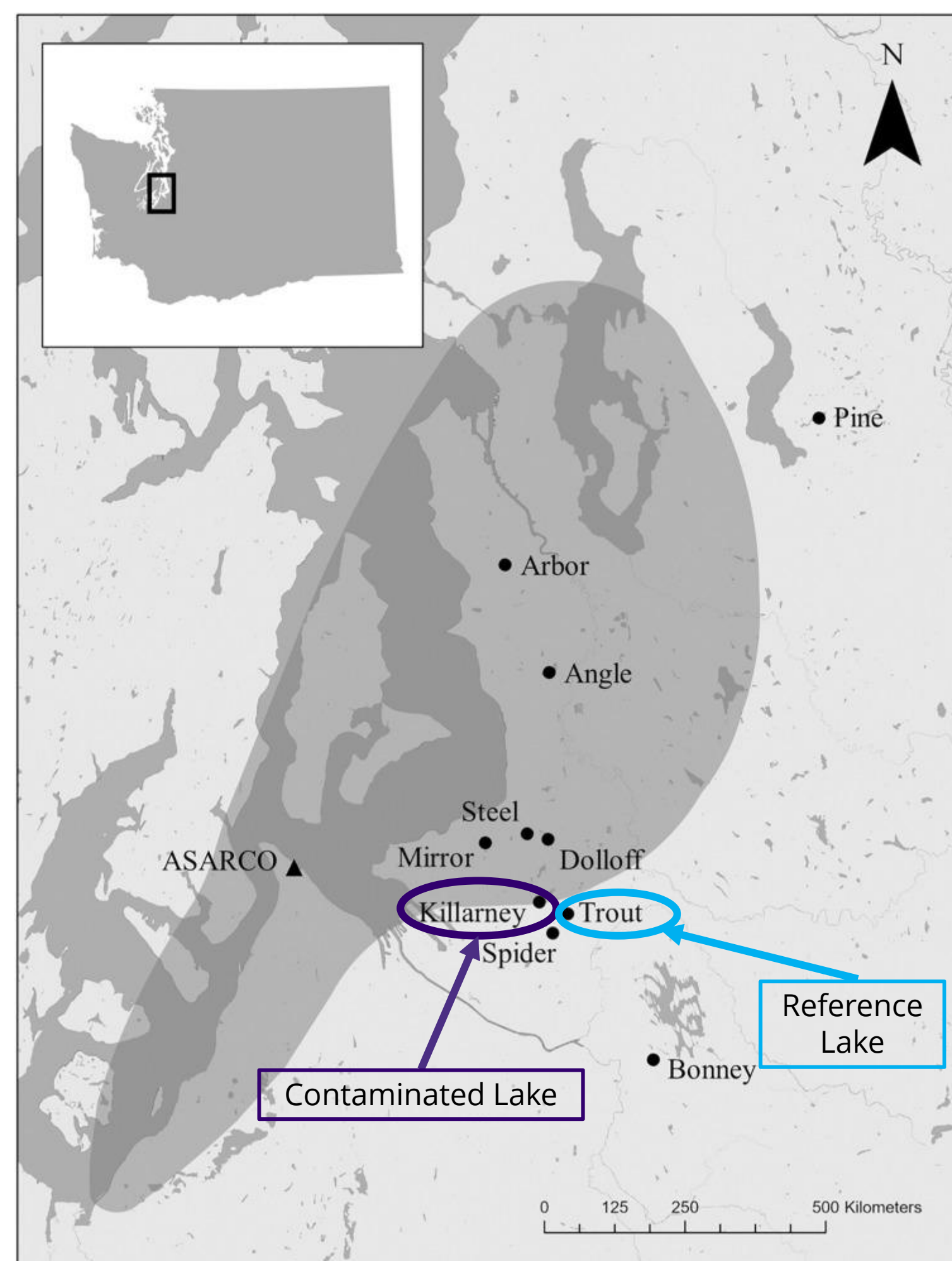
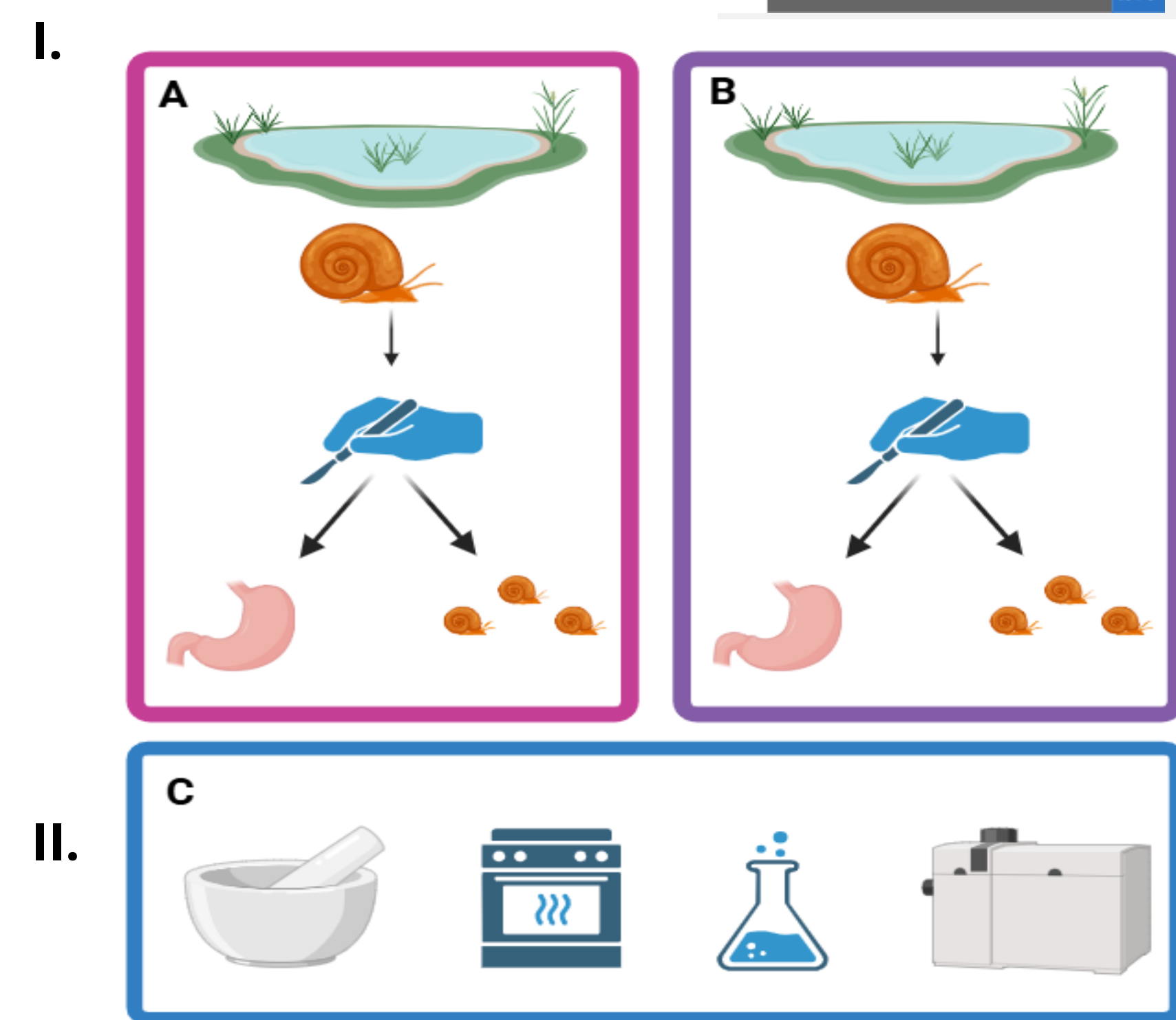


Figure 1: ASARCO smelter deposition zone and affected lakes. Lake Killarney (arsenic-contaminated lake) and Trout Lake (reference lake) have been identified with purple and blue arrows respectively. Image from Hull et al. 2023)

Methods



- I. Collection and processing of samples from Killarney (A) and Trout (B) Lakes:
 - Collect & dissect snails from lakes
 - Reserve tissues and unborn broods
- II. Measure arsenic content in tissues & broods (C)
 - Grind and bake samples to eliminate excess moisture
 - Perform nitric acid digest on samples.
 - Determine arsenic concentration with inductively coupled plasma mass spectrometry (ICP-MS)

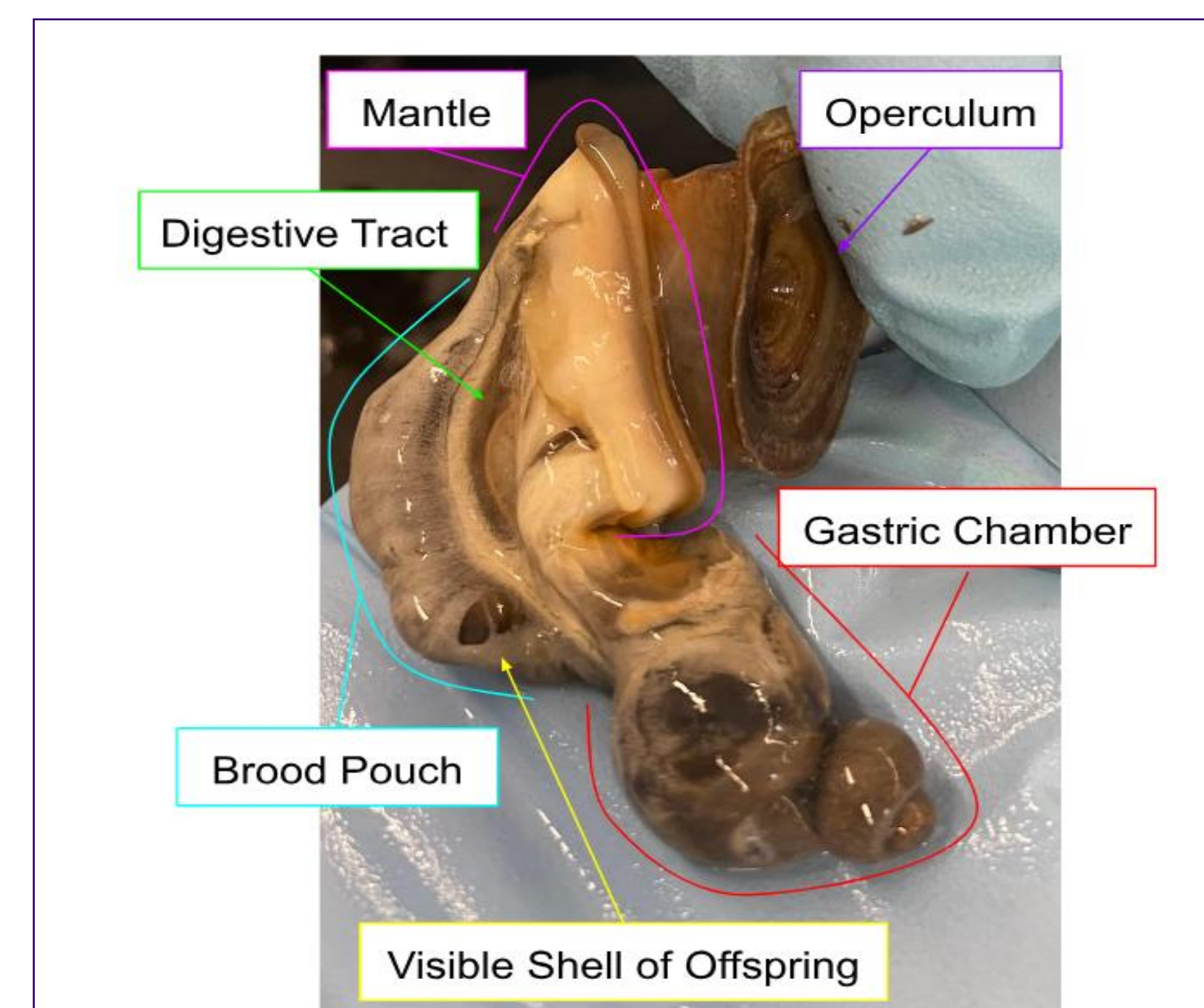


Figure 2: Chinese Mystery Snail Female Anatomy after removing the shell, head, and foot.

Findings/Results

- The brood pouch is located adjacent to the digestive tract; Bioaccumulation of arsenic is highest in digestive tract.
- Killarney broods had higher arsenic concentrations compared to Trout broods.
- The relationship between arsenic bioaccumulation and brood age/size was inconclusive in the Killarney broods.
- Trout broods showed a negative correlation between arsenic concentration and age/size.

Total Arsenic Concentration by Anatomical Compartment

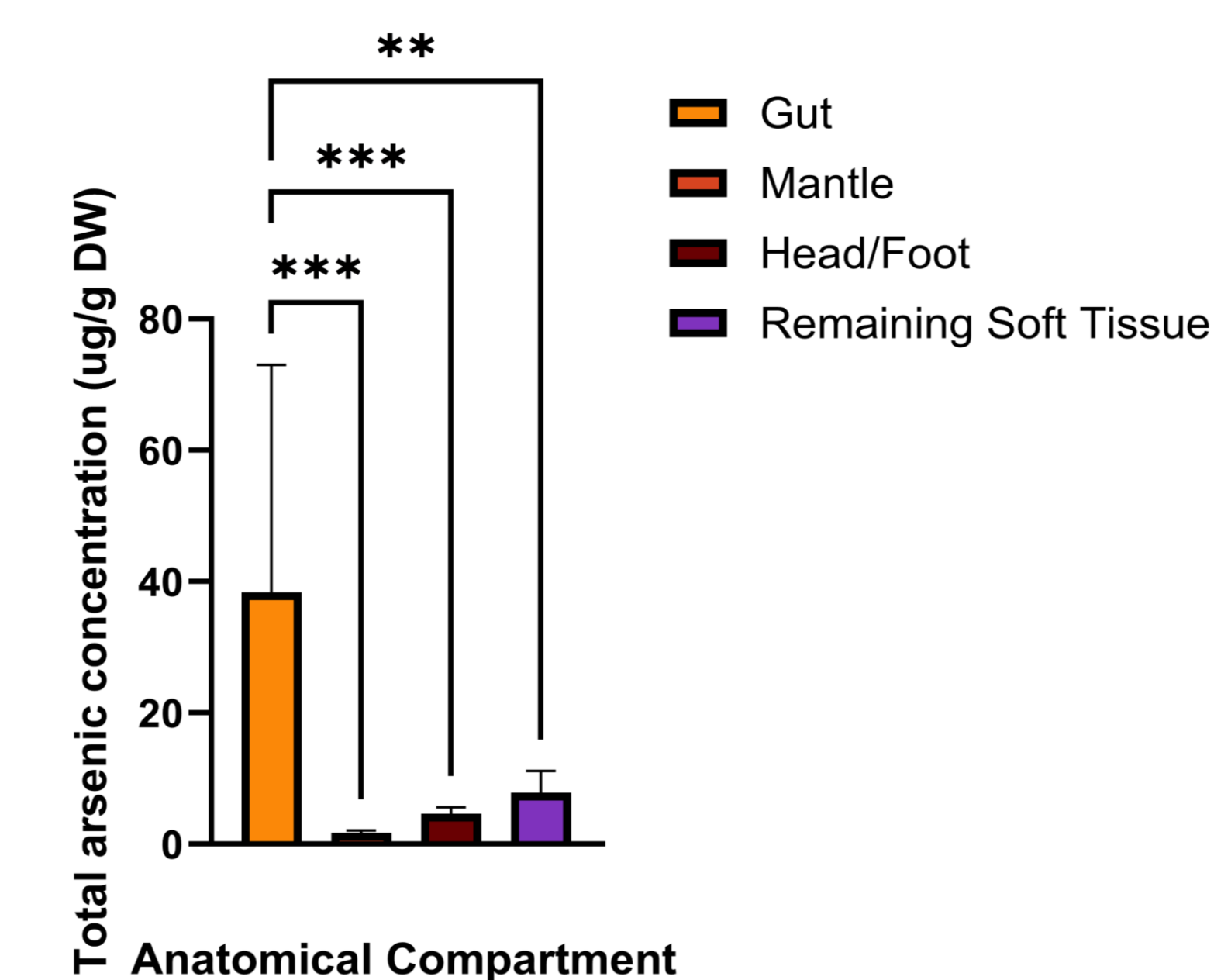


Figure 3: Elevated arsenic concentrations in the gut of adult snails from Lake Killarney. Error Bars represent the standard error of the mean. ** = $p < 0.01$; *** = $p < 0.001$.

Comparison of Killarney Brood Groups

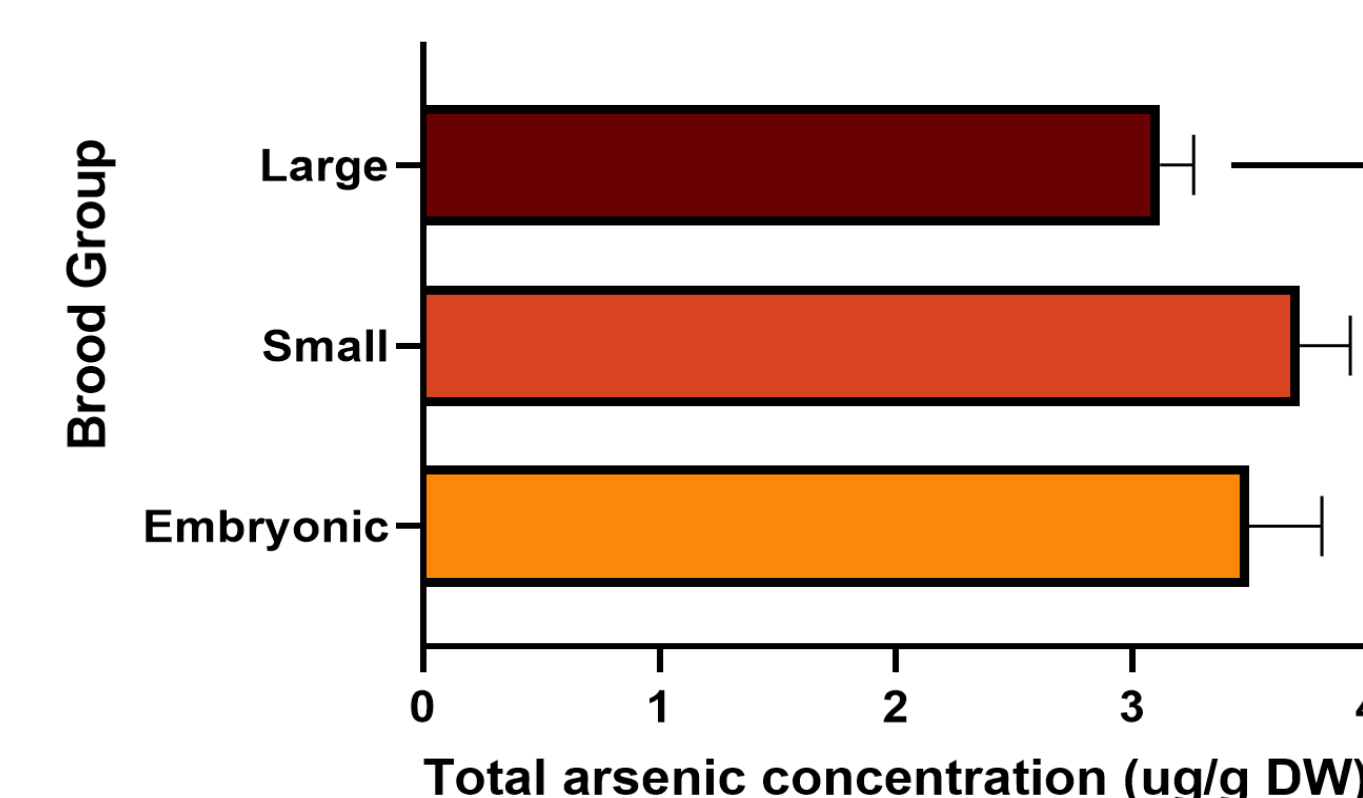


Figure 4: Elevated arsenic concentrations in brood snails from Lake Killarney. Total arsenic concentrations (DW = dry weight) in size groups were compared across Killarney samples. Error Bars represent standard deviations from the mean. * = $p < 0.05$.

Comparison of Killarney vs Trout Brood Groups

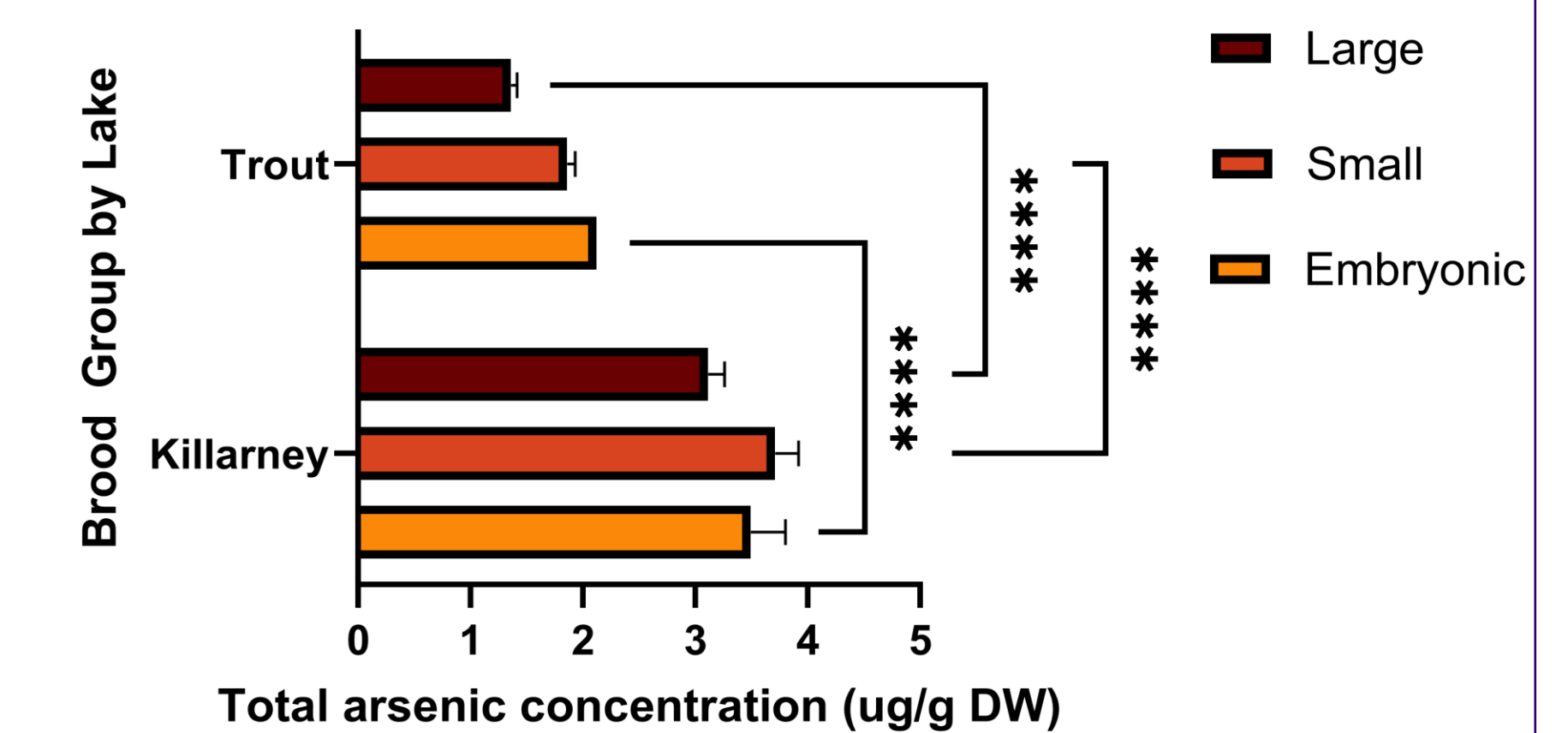


Figure 5: Elevated arsenic concentrations in brood snails from Lake Killarney compared to Trout. Error Bars represent standard deviations from the mean. Lack of error bar represents only one sample collected. **** = $P < 0.001$.

Conclusion

- Based on our dissections and ICP-MS results, maternal transfer of arsenic to developing broods is likely.
- The broods are in close proximity to the maternal digestive tract, which had the highest concentration of arsenic in adult snail tissue in both lakes.
- Broods from snails collected from the contaminated Lake Killarney had higher arsenic concentrations than broods from snails in the reference lake.
- This demonstrates a positive correlation between the maternal concentration of arsenic and the arsenic concentrations in developing broods.
- Future research will explore the mechanism behind this maternal brood transfer

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Scan for References!

