Radioactive Roots: Big Sage Brush on the Wind River Reservation

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Research Question

Does uranium influence root architecture of big sagebrush, *Artemisia tridentata,* on the Wind River Reservation?

Introduction

Environmental contamination is often the result of human interaction, while the cleanup process of these interactions is minimal. My research site is a former uranium processing mill near Riverton, WY. The mill was in operation from 1958 until it was closed in 1963. This mill continues to be a liability because of the traces of elements like uranium (Dam et al. 2015). The contamination negatively affects surrounding communities and the landscape as well (Favas et al. 2016). Big sagebrush (*Artemisia tridentata*), like all plant life, has biomass which determines the plants nutrient uptake from the soil. The Conceptual Site Model (CSM) developed in the 1990s, as stated by Dam et al., "determined that once the tailings source is removed, major groundwater process of advection, dispersion, and sorption would dominate contaminate migration. The original CSM coupled with numerical modeling formed the basis for the natural flushing compliance strategy that was approved by the US Nuclear Regulatory Commission (NRC) in 1998." (ibid. pg. 7256) The CSM requires revision because it did not account for natural flooding events.

Root Biomass & Mycorrhizal Fungi

Each plant has their own ability to manipulate rhizosphere conditions. The rhizosphere is a layer around the roots (approx. 3mm). Observing the microbial communities influence the overall plant health, one can then infer that uranium, being an element in root uptake, can influence the plant in some capacity (Yee et al. 2021). Mycorrhizal fungi is a soil component which supplies the plant roots with water and phosphate. Chemical reactions occur between plant roots and fungi, such as the exchange of sugar and water. According to Favas et al. (2016), certain species of plants are found to be more efficient at accumulating U from the ambient environment.

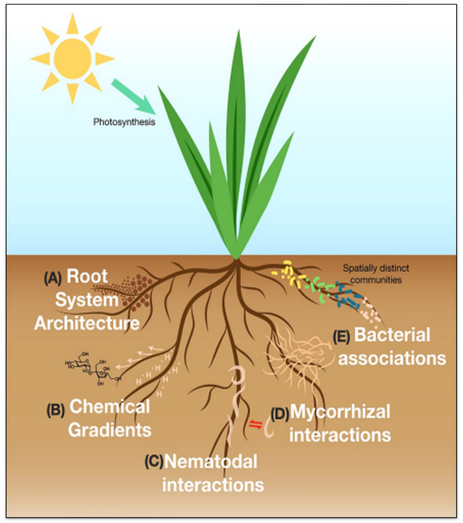

Figure C: image of plant root system

Study Area

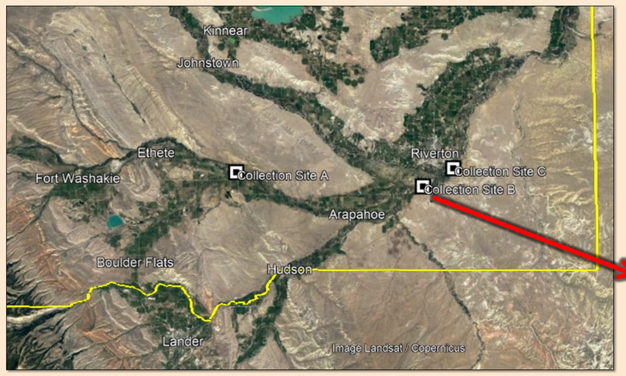

Figure A: image showing the boundary of the reservation and collection sites via Google Earth Pro

Figure A. shows my proposed sample collection sites, labeled A, B, and C. Site A being furthest upriver of the three, site B being the contaminated area, and site C, being the site further downriver of the Little Wind River.

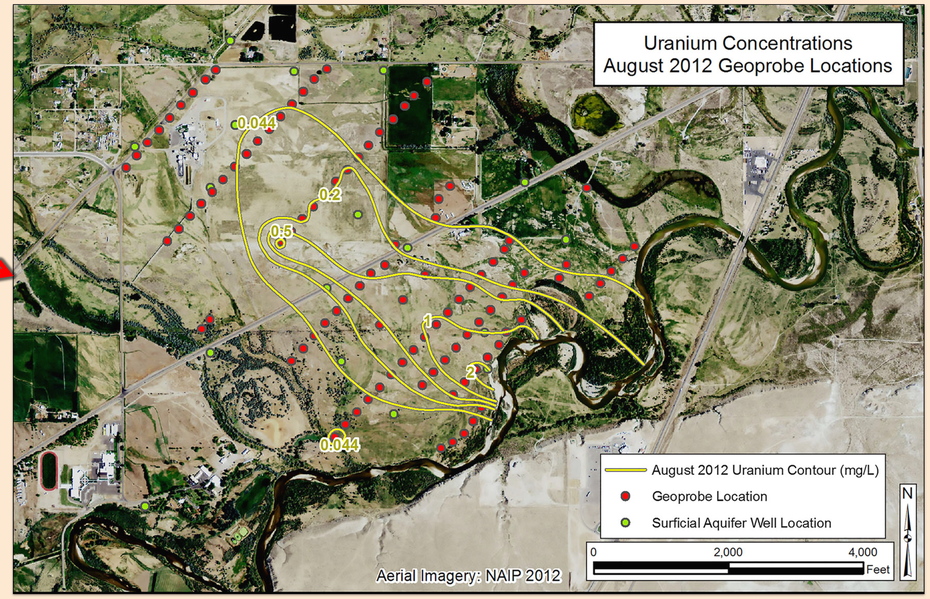

Figure B: image showing downgradient of uranium contamination into the Little Wind River

Figure D: image of sagebrush root structure

Methods

I will be utilizing two methods, Ground Penetrating Radar (GPR) and the collecting of sagebrush samples for root biomass analysis.

1. For GPR, the focus is to identify the root biomass system of the sagebrush and how far they extend to ensure an accurate extraction from the lateral roots to the bottom of the root biomass.
2. Samples will be collected from the designated sites A, B, and C (see fig. A) and then I will conduct a root biomass analysis on the sagebrush. I'll collect three samples at each site, all 100 feet apart. This method will identify if any U concentrations are affecting root biomass and root depth.

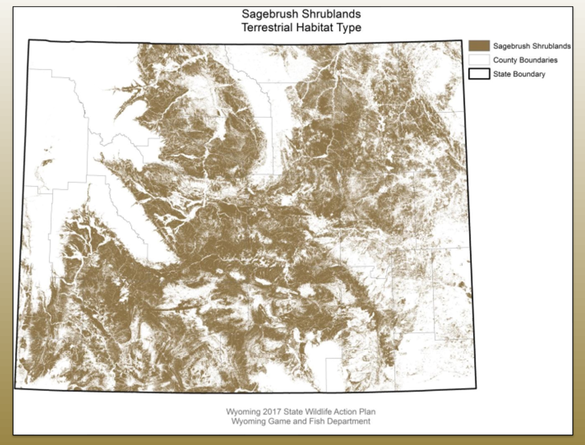

Figure E: geographic range of sagebrush in Wyoming

Hypothesis

In my proposal, I hypothesize a difference in root architecture in the contaminated sagebrush samples compared to the non-contaminated samples. In addition, I argue that there will also be differences in the root biomass, lifespan, and germination of samples in the contaminated area compared to the samples in the non-contaminated area.

Uranium

According to Geras'kin, Evseeva, and Oudalova (2013), radioactivity can lead to an increase in chromosome aberrations, a decrease in survival rates, and a decrease in germination in vetch plants. Big sagebrush, like the pine tree, is germinated by wind activity, with the exception that male pine cones need to find female pine cones to reproduce. One can argue that since germination processes are similar, that the influence of uranium on pine tree germination rates can be extrapolated to question the potential influence on big sage brush.

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