

# Mercury Accumulation in Spiders at the Great Salt Lake, Utah

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## INTRODUCTION

The history of the Great Salt Lake (GSL) ecosystem includes significant anthropogenic inputs of pollutants (including heavy metals) from agricultural, mining, and industrial sources (Naftz et al. 2008). High mercury (Hg) concentrations have been documented in the deep brine layer of the GSL and frequent mixing events in the water column transfer Hg into surface waters where it enters the aquatic food web (Wurtsbaugh et al. 2011). To approximate transfer of Hg from the aquatic food web to the terrestrial food web we measured Hg concentration of spiders collected near the water's edge, whose diet is primarily brine flies (*Ephydra sp.*).

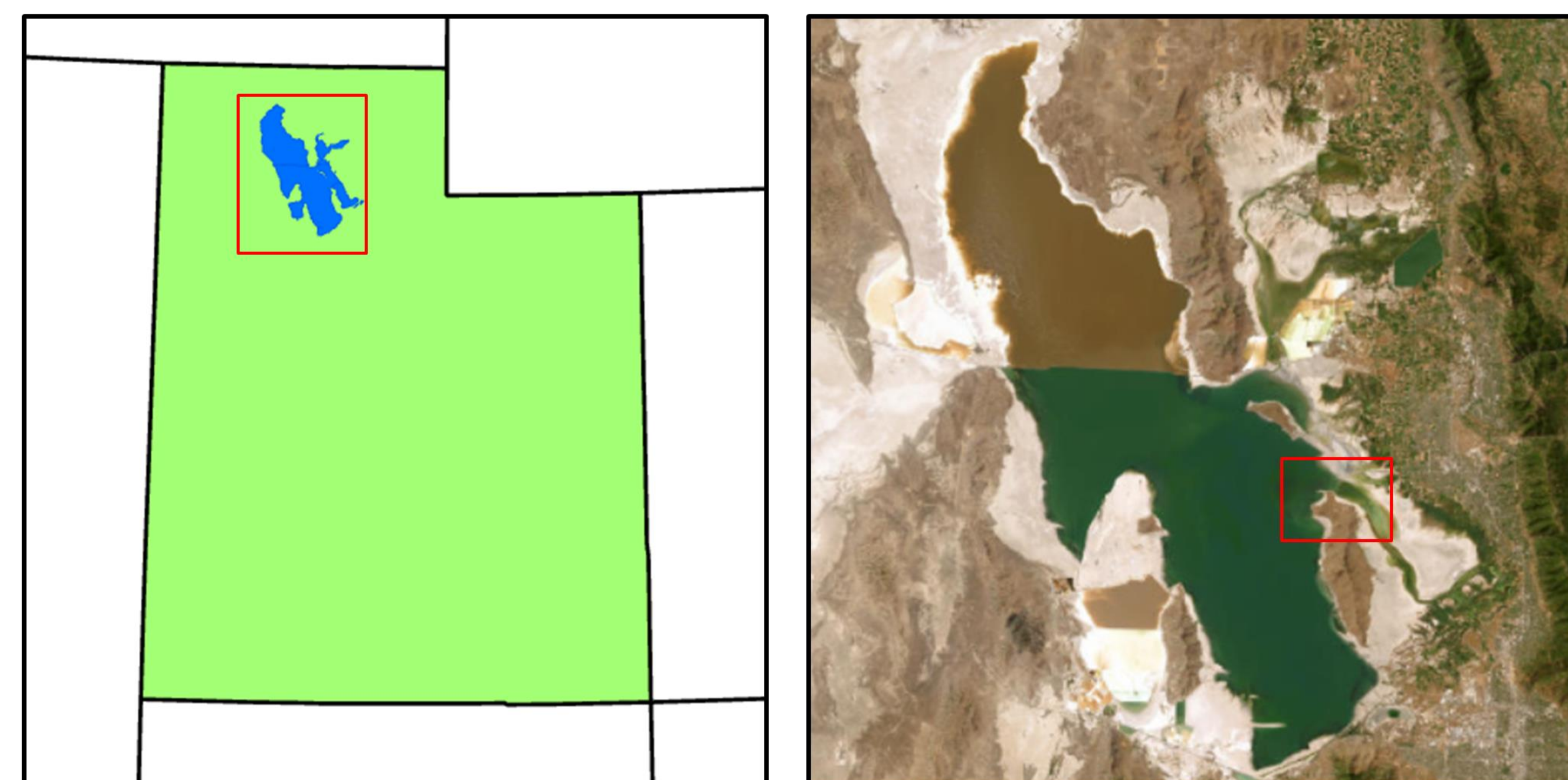
## OBJECTIVES

- 1) Determine Hg concentrations in western spotted orb weaver spiders (*Neoscona oaxacensis*) that link the aquatic and terrestrial food webs of the GSL through their diet of brine flies
- 2) Examine temporal and spatial patterns of Hg concentrations in this species at Antelope Island State Park.



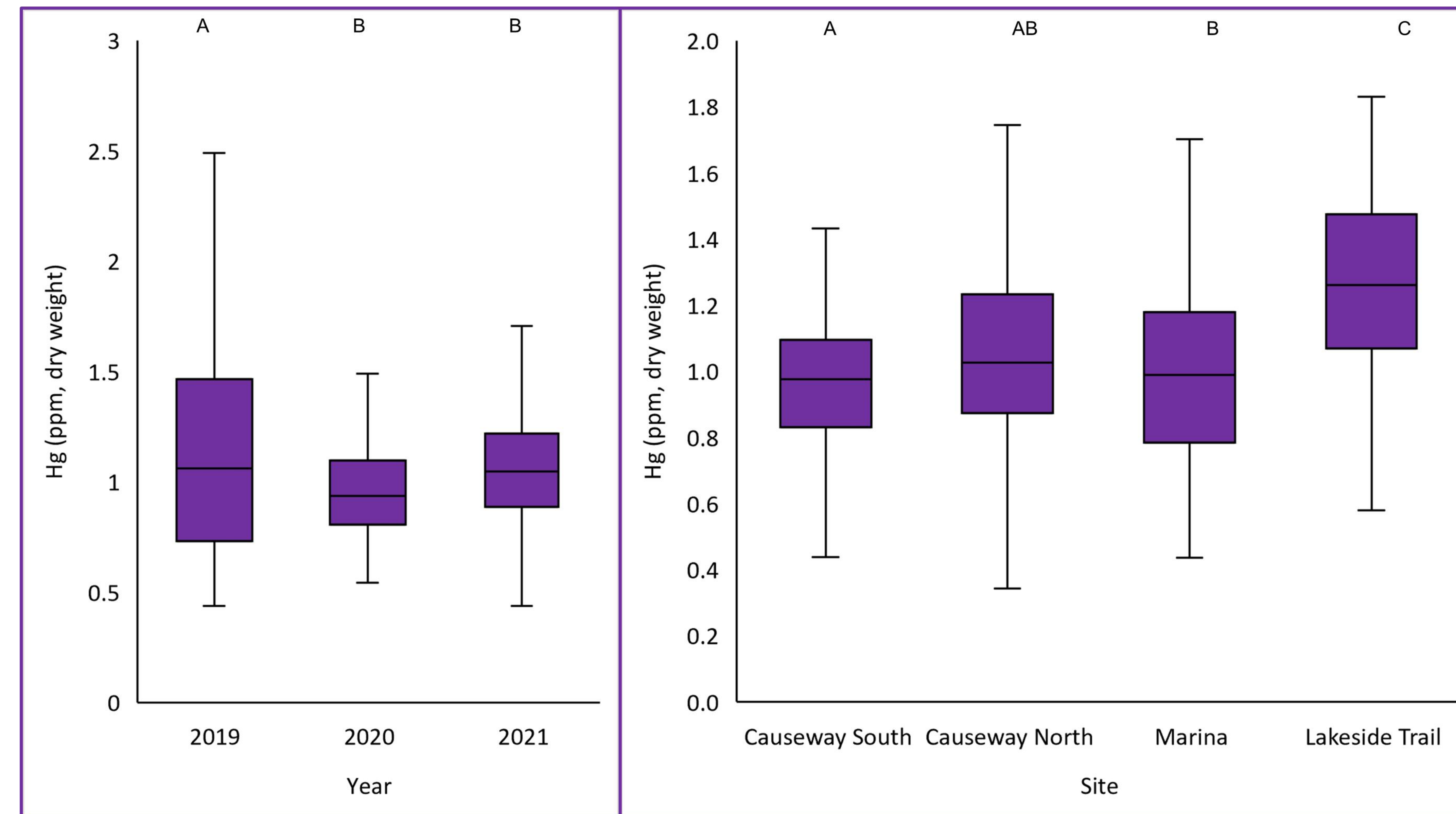
## METHODS

- Sweep nets were used to collect western spotted orb weaver spiders from four locations on Antelope Island during the summers of 2019-2021
- Collected spiders were frozen (-20°C) until analysis
- Whole spiders were dried and analyzed for total Hg concentration (ppm, dry weight) using a Nippon MA-3000 Direct Mercury Analyzer
- Effects of year and site on Hg concentrations were evaluated with one-way ANOVA and Tukey's post-hoc analysis
- Satellite imagery was used to construct a map of water level from 2019-2021 approximate distance to water for each site and year



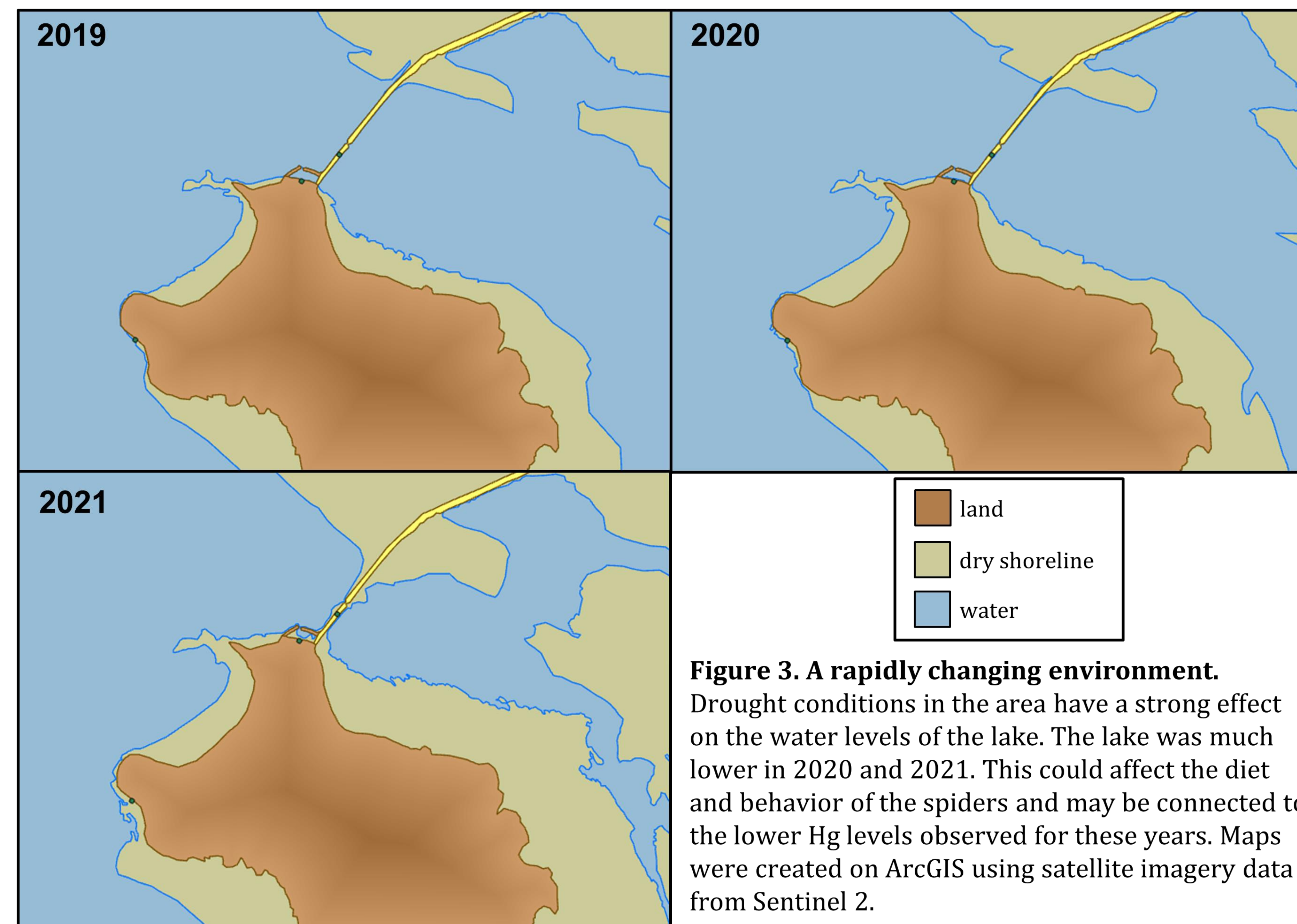
The Great Salt Lake and Antelope Island

## RESULTS



**Figure 1. There was a significant effect of year on Hg in spiders** ( $F_{2,565}=36.0$ ,  $p<0.001$ ) in which all years showed significant differences in Hg. Hg concentrations were highest in 2019 ( $p<0.001$ ) and lowest in 2020 ( $p<0.001$ ).

**Figure 2. There was a significant effect of site on Hg in spiders** ( $F_{3,565}=25.9$ ,  $p<0.001$ ). Spiders collected along the Lakeside Trail had significantly higher Hg concentrations than all other sites ( $p<0.001$ ). Hg tended to be higher in spiders collected at the Marina compared to spiders collected at Causeway-Farmington Bay ( $p<0.001$ ), but not Causeway-North. No difference in Hg was detected between spiders collected on either side of the Causeway.



**Figure 3. A rapidly changing environment.** Drought conditions in the area have a strong effect on the water levels of the lake. The lake was much lower in 2020 and 2021. This could affect the diet and behavior of the spiders and may be connected to the lower Hg levels observed for these years. Maps were created on ArcGIS using satellite imagery data from Sentinel 2.

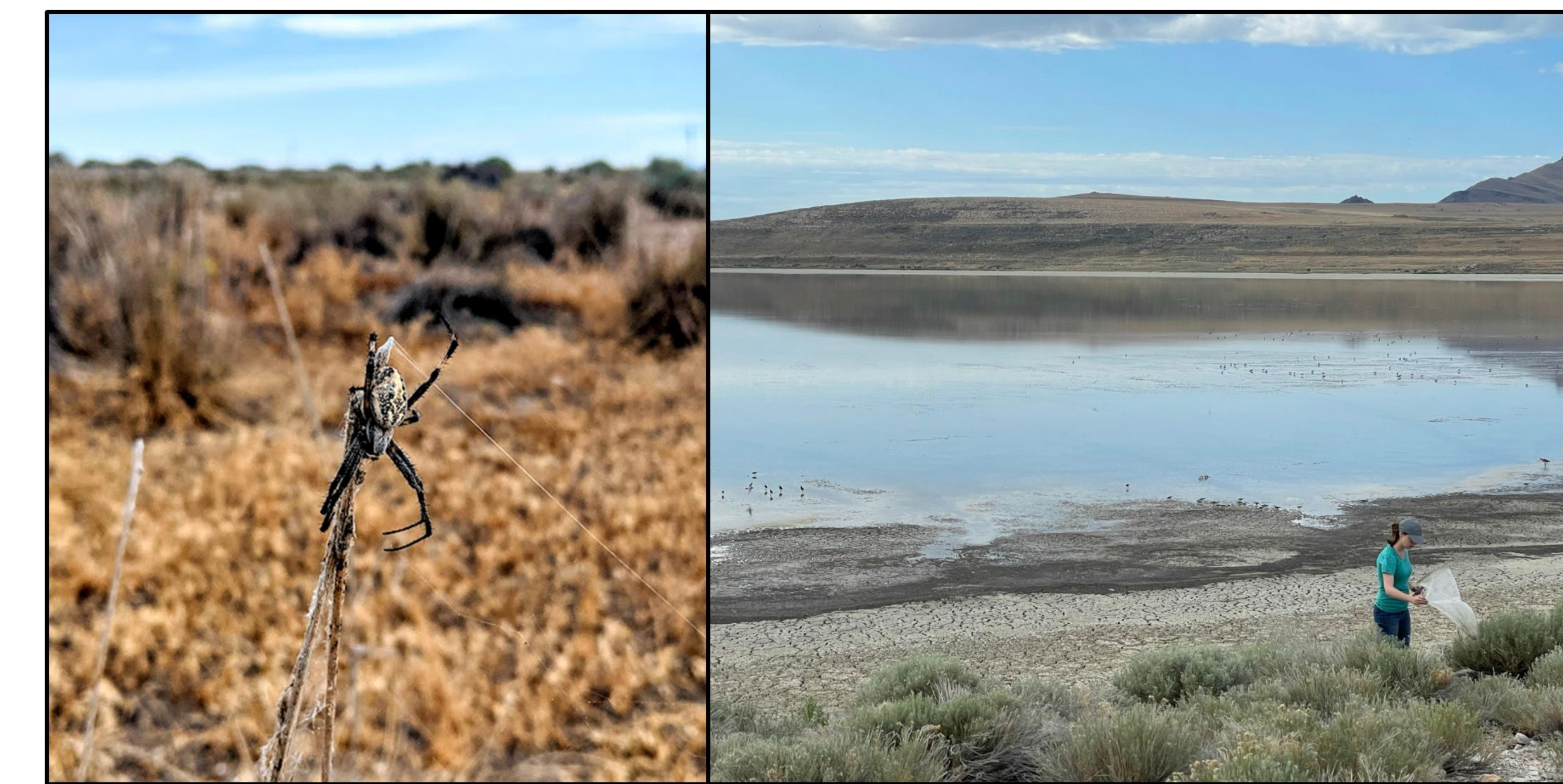
## DISCUSSION

We found a significant effect of year on Hg; Hg in 2019 was significantly higher than in 2020 and 2021 (Figure 1). The bioavailability of Hg in any ecosystem varies with environmental conditions. Hg concentrations in spiders also varied by site. Spiders collected along the Lakeside Trail had the highest Hg concentrations (Figure 2). This could mean Hg is more bioavailable in that area, or that the spiders in that area are more dependent on food sources that have higher Hg levels. As the Lakeside Trail site was only sampled in 2021, continued collection in the future will help determine if this site has consistently elevated Hg.



Due to exceptional drought conditions in 2020 and 2021 the water level of the lake was extremely low (Figure 3). This may have driven spiders to consume non-aquatic prey. Therefore, annual change could be the result of a dietary shift. Hg in spiders collected from the marina, which become landlocked when water levels are low, went down in drought years, while Hg in spiders collected from the causeway increased in drought years. There was an overall trend of increasing Hg with increasing distance to water (Figure 4).

Continued sampling at Antelope Island on an annual basis will help us better understand the movement of Hg out of the GSL and into the terrestrial food web and how it is affected by drought conditions.



## ACKNOWLEDGEMENTS

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