Plant Biodiversity and Community Dynamics in an Intact Sagebrush Steppe Ecosystem

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Background

- Global biodiversity losses are occurring rapidly due to climate change and habitat fragmentation (Jimenez et al. 2024).
- The Idaho National Laboratory (INL) hosts the largest existing intact segment of critically imperiled sagebrush steppe habitat, an ecosystem which supports unique flora and sagebrush-obligate fauna (Anderson and Inouye 2001).
- Ecology interns collect data for the Habitat Condition Monitoring task to support sage-grouse conservation efforts of DOE-ID and USFWS.
- Assessing metrics of floral biodiversity over time at the INL may provide insight into sagebrush steppe community responses to climate in a uniquely protected setting with long-term annual monitoring data.

This leads us to ask:

Are plant diversity metrics and community compositions stable over time in an intact ecosystem?

Big Sagebrush Shrubland
Dense shrub layer of sagebrush species. Green rabbitbrush and native grasses can be present, however they don't contribute substantial cover.

Big Sagebrush - Green Rabbitbrush Shrubland
Moderately dense shrub layer of sagebrush species. Other shrubs may be common to co-dominant such as green rabbitbrush.

Black Sagebrush Shrubland
Black sagebrush dominates the shrub stratum with Sandberg bluegrass dominating the herbaceous cover.

Western Wheatgrass Grassland
Dense cover of native rhizomatous grasses such as western wheatgrass. Shrubs add sparse cover.

Methods

- Data were analyzed from the 2014-2023 dataset for the following metrics: species richness (metric for alpha diversity - the number of distinct plant species found in a plot), plant community classification, and nativity status.
- Standard deviation was calculated for species richness for each plot and beta diversity (Figure 1) using Jaccard Index (spatial and temporal) and precipitation data are from the CFA monitoring station.

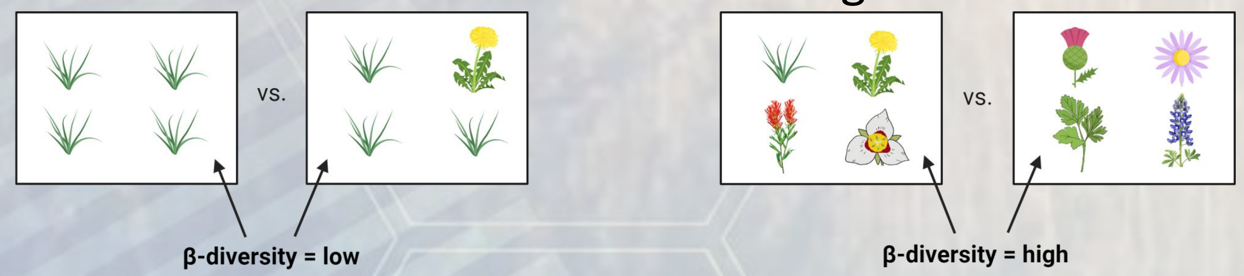

Figure 1. Beta diversity measures the proportion of species in common between two separate communities.

Results

- Alpha diversity slightly increased from 2014-2023 (Figure 2).
- Alpha diversity shifts appear to be associated with precipitation (Figure 2).
- Introduced species generally increased from 2014-2023 (Figure 3).
- Beta diversity showed a stable pattern of heterogeneity over time (Figure 4).

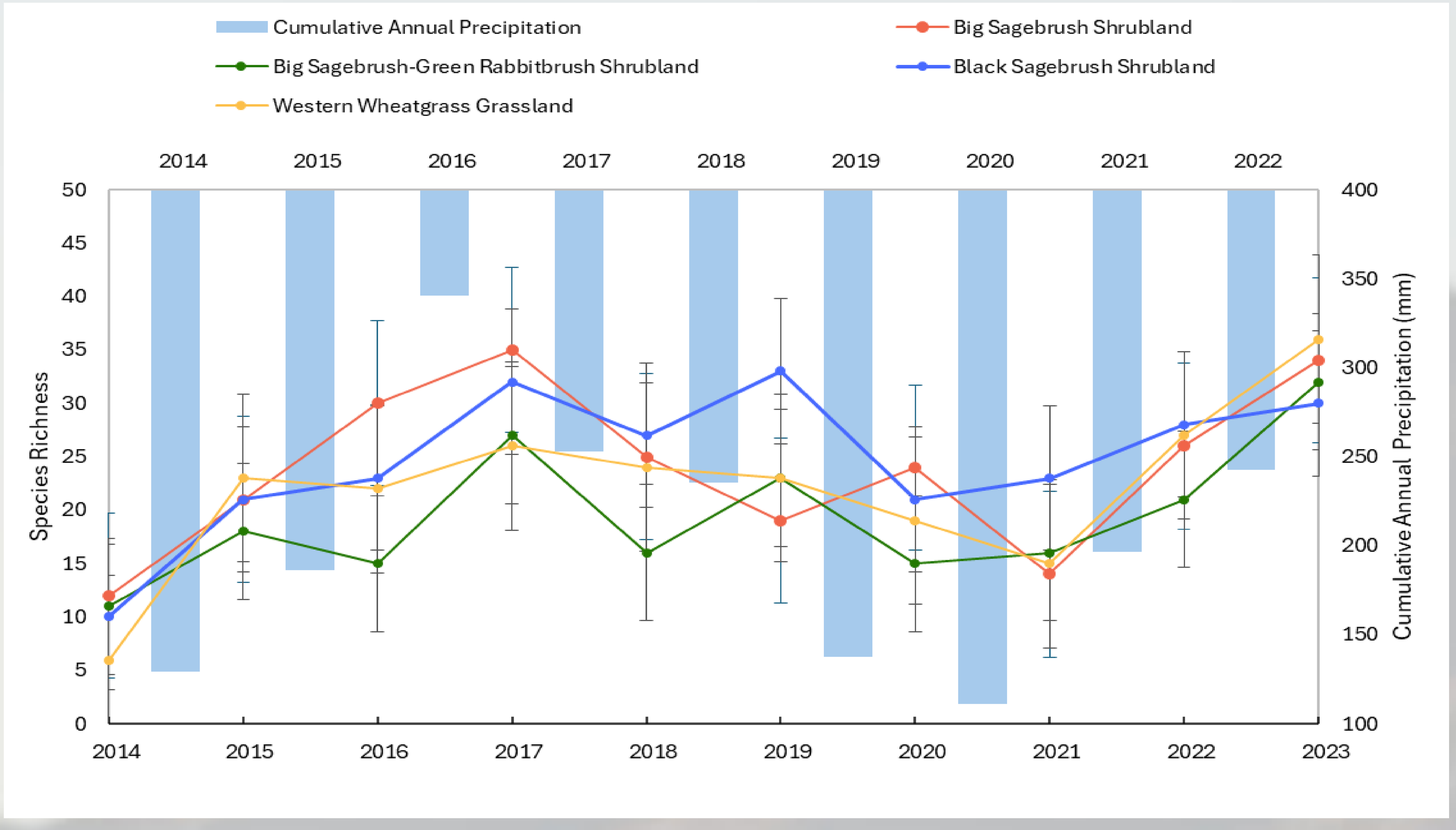

Figure 2. Alpha diversity characterized by species richness from 2014 to 2023 in four distinct plant communities.

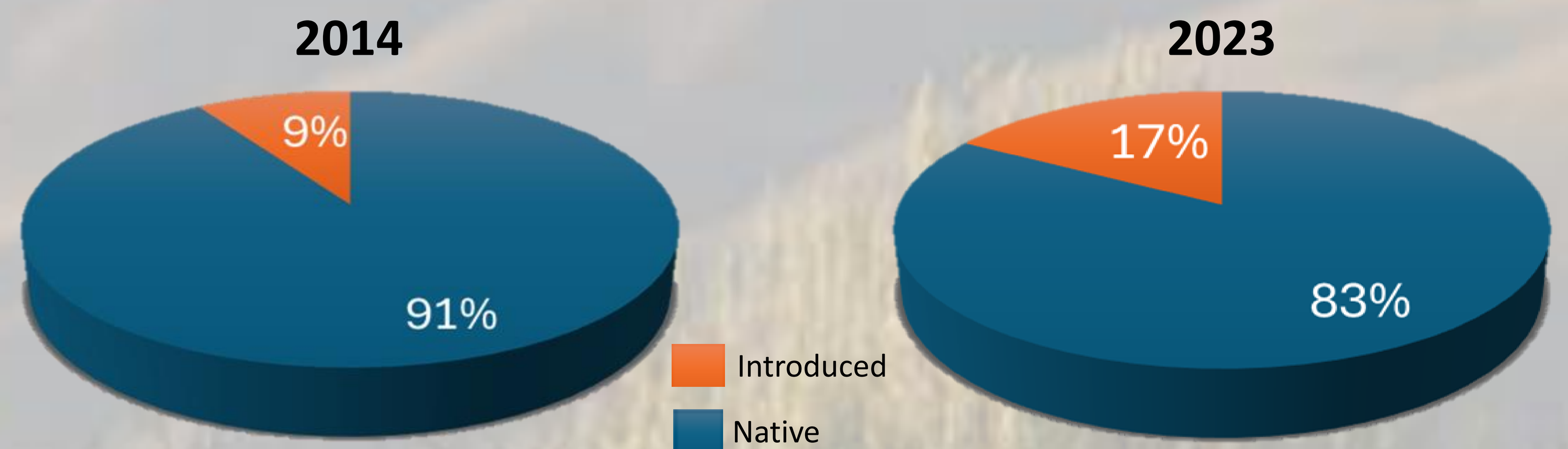

Figure 3. In 2023, introduced species comprise a greater percent of total species in the landscape than in 2014.

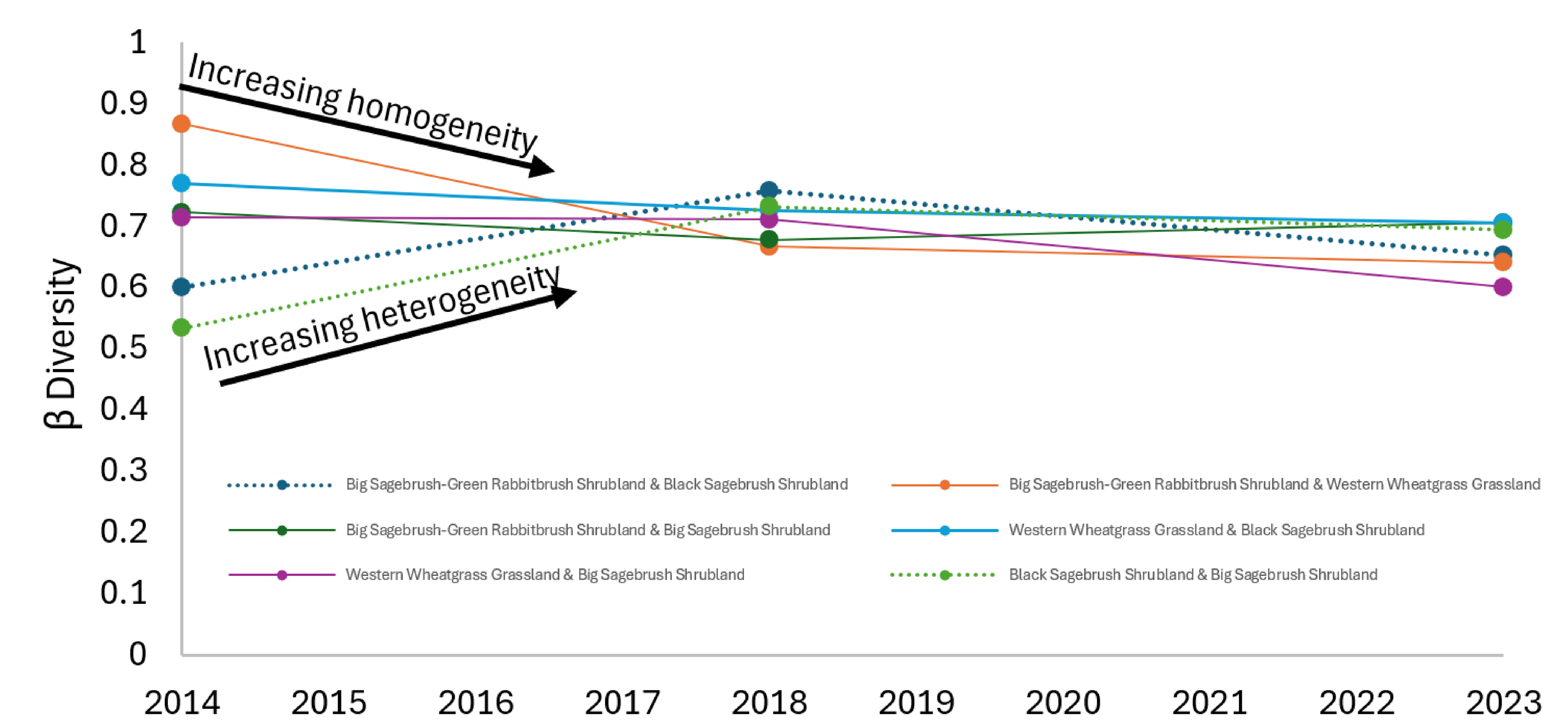

Figure 4. Spatial beta diversity as 1- Jaccard Index for 4 distinct plant communities.

Discussion

- Alpha diversity generally increased over time across all plant communities.
- These alpha diversity shifts are likely primarily driven by interannual variation in regional weather patterns.
- Observed stability in beta diversity indicates distinct plant communities are continuing to host unique species and contribute to the overall floristic diversity of the landscape (Mori et al. 2018).
- Species richness alone is not a sufficient measure of habitat quality but can provide valuable insight into community dynamics and structure over time.

References

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Battelle Energy Alliance manages INL for the U.S. Department of Energy's Office of Nuclear Energy

Idaho National Laboratory

Acknowledgements - Special thanks to Kristin N. Kaser, Kurt T. Edwards, and Steph M. Magee, George J. Krauszer II