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Remotely-Sensing Chemical Diversity and Function of Native Plants Across Sagebrush-Steppe Landscapes

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Why does plant chemical diversity matter?
Plant chemicals provide ecosystem services and values:
• Influence wildlife biodiversity and health
• Promote food security
  – Diverse agricultural plots are more resilient to disease
• Are sources for medicinal, agricultural, and technological advances
  – Examples: Opium, Taxol, pesticides, biofuel

The sagebrush-steppe is an ideal ecosystem for chemical diversity arising from plant-herbivore interactions

Remote sensing is the key
Detecting, monitoring, and mapping plant diversity is expensive, time intensive and does not capture functional traits

Solution: Remote sensing using spectroscopy (e.g., near infrared spectroscopy (NIRS), hyperspectral) provides rapid quantitative measurements of plant traits without contact
• Spectroscopy produces unique fingerprints based on organic bonds that predict geophysical quantities and chemical traits of plants
• Publicly-made spectral data is low resolution and large-scale
• Spectrometers on handheld devices and attached to unmanned aerial systems (UASs) provide higher resolution and finer-scale data (Fig 1)

Research Questions
1. Species Diversity: Can spectroscopy differentiate plant species in the sagebrush-steppe ecosystem at increasing spatial scales?
2. Chemical Diversity: Can spectroscopy predict known functional phytochemical differences among plants at increasing spatial scales?

Methods
1. Species Diversity: Use handheld NIRS and hyperspectral sensors from UASs to determine species of sagebrush from images of single shrubs (Fig 2) & patches of plants (Fig 3).
2. Chemical Diversity: Use handheld NIRS and lab-performed chemistry to predict chemical diversity from leaves, whole plants, and patches (Fig 4).
3. Mapping: Build taxonomic / chemical diversity maps and indices from spectral data overlaid onto spatial data (Fig 5).

Remote sensing offers multiple advantages
• Relatively cheap, rapid, precise method to map plant diversity that provides information on functional traits
• Spectrally-obtained diversity data can be used to predict herbivore habitat use, monitor plant communities after restoration efforts, and identify hot-spots of chemical diversity for drug discovery

References & Acknowledgements
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