Phenology-based UAV remote sensing for classifying invasive annual grasses to the species level

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The spread of invasive plant species severely alters wildfire regimes, degrades critical habitat for native species, and has detrimental impacts upon ecosystem function, rangeland productivity, and dynamics of long-term carbon storage. Remote sensing technology has greatly improved our understanding of invasive plant ecology. Mapping species invasions with conventional satellite and airborne data has proven challenging, however, because it is difficult to map invasive plants to the species level. Many invasive species occur at fine spatial scales or are mixed with native species and satellite passes may occur too infrequently to capture important phenological stages.

We capitalize on species-specific differences in plant phenology and use high resolution Unmanned Aerial Vehicle (UAV) imagery to classify invasive annual grasses (cheatgrass and medusahead) to the species level and distinguish them from native species. UAVs can produce images at the centimeter scale, avoiding the 'mixed-pixel problem' where larger pixels encompass multiple cover types and plant species. Our study addresses this challenge by employing a novel combination of spectral, textural, structural, and multitemporal phenology-based classification techniques. Our approach distinguishes invasive plant species from one another and from the dominant species of native vegetation within which they are embedded, increasing the utility of remote sensing data in invasive species management.