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Title: Classification of a heterogeneous grassland ecosystem to detect spotted knapweed (*Centaurea maculosa*) using remote sensing

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Abstract

The ability to accurately detect and quantify the presence of invasive plants is integral in their management, treatment, and removal. Unpiloted aerial vehicles (UAVs) are becoming an important remote sensing tool for mapping invasive plants. Spotted knapweed (*Centaurea maculosa*) is highly invasive in North America. This study focused on using multispectral data collected with a UAV to map the relative cover of spotted knapweed in a heterogeneous grassland community. A new method of image analysis was developed, in which a multispectral image was segmented into a grid of metapixels for which gray level co-occurrence matrix-based statistics were computed as descriptive features. Plant species inventories performed on 1 m² quadrats were used to provide ground-reference measurements of the relative abundance of spotted knapweed within these metapixels. A random forest classifier was trained to predict the qualitative degree of spotted knapweed ground cover within each metapixel. The best overall accuracy achieved was 73.1% when describing relative ground cover of spotted knapweed. Analysis of the performance of metapixel-based image analysis on this study site suggests that feature optimization, including feature subset selection, is of critical importance when creating a high-performance classifier, and that higher spatial resolution does not necessarily improve classification performance.