Using drones and image analysis to monitor jack pine regeneration after fire

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Understanding jack pine revegetation after fire is important for improving sustainable timber harvest practices and for providing suitable wildlife habitat for Kirtland's warbler. Remote sensing imagery allows researchers to rapidly assess environmental data after fire, but satellite imagery often has poor quality spatial resolution or may be cost-prohibitive at high spatial resolution.

In contrast, unmanned aerial systems (UAS) may provide imagery with greater spatial and temporal resolution and reduced atmospheric noise relative to imagery from manned aircrafts and satellites. UAS imagery may be used to generate digital surface models with the potential for individual tree detection (IDT), an application with important implications for forest management. Photogrammetric methods vary in their tree identification accuracy, and there is a need to develop cost-effective and computationally-efficient IDT methods.

White et al. (2019) assessed the accuracy of UAS and image analysis for identifying individual jack pine tree saplings after the 2012 Duck Lake wildfire, which burned almost 9000 ha in Michigan's Upper Peninsula.

Five years after the fire, researchers used a 3DR IRIS quadcopter to acquire aerial images of two small subunits (100 m^2) of mixed conifer-deciduous woodland within the burned area. The UAS was equipped with a multispectral camera that captured visible (RGB), red edge (RE), and near infrared (NIR) spectral band imagery. Pix4D software was used to create orthomosaics of each of the spectral bands, and multispectral composite mosaics were created in ArcMap. (*Cont. on page 2)*


Photo credit: R. Portelli

MANAGEMENT IMPLICATIONS

1. Low-cost drone surveys and image analysis could be applied to studies of succession in conifer forests and oak savanna regeneration after fire.

2. UAS-GEOBIA provided the greatest tree identification accuracy under conditions of low tree density and low moisture.

3. In this study, the accuracy of sapling counts improved between the June and August measurement dates.

4. Ground-based data are important for improving the accuracy of remote sensing tools that are likely to become increasingly valuable for managing forests in the future.

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Geographic Oject-Based Image Analysis (GEOBIA) using statistical classification methods (the "random forest" aproach) then enabled the researchers to identify and classify individual trees based on a training data set of 40 trees and 200 non-trees. GEOBIA results were used to analyze the effects of season and low sapling density on tree identification accuracy.

Authors were able to identify young jack pine saplings, ranging from 1 – 5 feet tall, with up to 90 % accuracy using drone-acquired multispectral imagery. Sapling count accuracy improved from 75 % in late June to 82 % later in the growing season (August), which may be due to differences in jack pine needle growth or seasonal differences in temperature and moisture. When comparing spectral features, the difference between NIR and red spectral bands provided the most accurate sapling identification. Sapling identification accuracy was also greater for the low sapling density plot than for the high density plot. Future UAS-GEOBIA studies may be improved by collecting ground-based data for a reference dataset, by increasing the number of reference points used, and by using external GPS orthorectification to compare a series of images for temporal analysis.

Reference

White, R., Bomber, M., Hupy, J., Shortridge, A., 2018. UAS-GEOBIA Approach to Sapling Identification in Jack Pine Barrens after Fire. Drones 2, 40. https://doi.org/10.3390/drones2040040