

The Bioindicators of Forest Condition Project: A physiological, remote sensing approach

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Abstract

Objective measures of forest ecosystem condition are needed to gauge the effects of management activities and natural phenomena on sustainability. The Bioindicators of Forest Condition Project seeks to develop a Forest Condition Rating (FCR) system using a physiological, remote sensing approach. In particular, the goal of the project is to test whether hyperspectral remote sensing may be used to infer stand-level information about pigment concentration, chlorophyll fluorescence, and other physiological features of condition. The project spans a four-year period of intensive sampling in tolerant hardwood forests in Ontario using the Compact Airborne Spectrographic Imager (CASI). For each airborne campaign, concurrent ground-based sampling for leaf physiological features was performed. Controlled laboratory and greenhouse studies were also conducted to derive relationships between leaf-based spectral measurements and physiology in the presence of environmental stresses. The project has identified several promising bioindicators of strain that are discernable from hyperspectral images and related to ground-based physiology. The most promising remote indicator for semi-operational testing is estimation of chlorophyll content, which can be used to classify maple stands on a five-stage scale of health. Chlorophyll fluorescence has also been discerned from spectral signatures, but our studies indicate it may be confounded by chlorophyll content. The intent here is to update the forestry community on progress made, insights gained and the practical implications of the research.

Keywords: chlorophyll fluorescence, hyperspectral, indices, pigments, reflectance, tolerant hardwoods