

The Characterisation of Heather Foliage and Canopies by Hyperspectral Reflectance

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Abstract

Heather dominated uplands form a significant proportion of Scotland's land area and are of significant economic and aesthetic value, of international importance for biodiversity conservation, a hydrological buffer, and are intimately linked to the global carbon cycle. Current management practices are considered to be causing the decline of these areas and climate change may be contributing. The extent and remoteness of upland moors makes manual survey problematic for monitoring ecological and phenological change. Remote sensing offers a complimentary approach but little is known of the detailed reflectance properties of heather. Greater understanding is required of the effect of variations in key biophysical and biochemical parameters influencing the spectral reflectance of heather canopies. Similarly, little has been done to relate the reflectance properties of heather to ecological community membership or to investigate the influence of phenological changes on its reflectance.

Research plots representing each recognised heather age classes and located in distinctly different ecological communities have been established on an upland moor. High spectral and spatial *in situ* reflectance measurements and measurements of key biophysical and biochemical variables influencing reflectance have been acquired from these sites over a number of growing seasons. Heather canopy samples were selected and removed to a laboratory and reassembled to allow detailed high spectral and spatial resolution measurements. Canopy components were then separated and dried for biomass and water content determination. Shoot and leaf samples were 'stacked' and further reflectance spectra acquired. Finally a proportion of the stacked shoots and leaves were used to determine proximate pigment content by wet chemistry methods.

Large variability has been measured in both biophysical and biochemical variables and significant levels of foliar Anthocyanin noted. Poor correlation was found between published universal pigment indices and measured Chlorophylls and Carotenoids content. Distinct changes in shoot and leaf reflectance related to foliar development and senescence were noted. There was an increase in green reflectance to a point of maximum value in late June then a general reduction through the remainder of the growing season. A marked reduction in foliar Chlorophyll content was found in reflectance spectra coincident with the onset of flower development. No differentiation between the age classes and ecological community memberships of the heather samples could be determined from reflectance measurements performed on shoots and leaves. However, changes in red reflectance observed at the onset of flowering did relate to age class and ecological community membership for some research plots.

Imaging spectroscopy using the NERC ARSF Eagle/Hawk platform is now proposed to determine if reflectance features observed in the laboratory are expressed in hyperspectral images. The paper will present the preliminary results of this research project and discuss the implications for monitoring change in upland ecosystems using spectroscopic methods.