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Connecting landscape function to hyperspectral reflectance in a dry sub-humid native grassland in southern Queensland, Australia

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Native grasslands cover over 80% of significant ecosystems in Australia, stretching across arid, semi-arid, tropical, sub-tropical and savannah landscapes. Scales of pastoral operations in Australia range from hundreds of hectares to thousands of square kilometres and are predominately found in regions with highly variable rainfall. Land use is governed by the need to cope with droughts, floods and fires.

Resilience to climatic extremes can be attained through effective soil management. Connecting landscape function on the fine scale to broad land management objectives is a critical step in evaluation and requires an understanding of the relevant spectral properties in remotely sensed images. The aim of this study was to assess key landscape function indices across spatial scales in order to examine their correlation with hyperspectral reflectance measurements. The results from this study could be applied as a model for land management centred on remote sensing.

The study site is located at Stonehenge (southern Queensland) on a moderately deep texture contrast soil with hard setting gravelly topsoil. Mean annual rainfall of 667 mm supports open forest and native perennial pastures with a diverse biocrust dominated by N-fixing cyanobacteria. Land use history is continuous grazing however; it had been destocked for several years prior to our study. There was some evidence of cattle, kangaroos and feral herbivores (rabbits, deer and goats) although impacts appeared to be minimal.

We established four land cover types: native pasture – NP1 (∼100% FPC - foliage projective cover), native pasture – NP2 (∼50% FPC, 50% biocrust), natural bare soil – BC (>80% biocrust), bare and eroded soil – BE (<1% biocrust). Duplicate 0.25 m2 quadrats of each land cover type were selected contiguous with a 100 m transect across the slope. The quadrats were analysed as five micro-transects with each row consisting of five sub-cells. Stability, infiltration and nutrient cycling indices were measured in each sub-cell. Hyperspectral data were also collected at an overall and sub-cell level, under wet and dry conditions and, with FPC removed in order to record the presence of biocrusts. For each micro-transect, soil samples were taken at 0-1 cm and 1-5 cm depths for isotopic C and N, C:N ratio, and plant-available N analysis. The results were adapted at a landscape scale to represent whole paddock management.

Preliminary results from the hyperspectral data indicate a clear delineation between native pastures, biocrusts and, bare and eroded soil. Landscape function fell away across all indices between NP1 and BE where; stability declined from 70 to 55%; infiltration from 36 to 25% and, nutrient cycling from 29-14%. By tapping into remote sensing, productivity improvements can be gained through targeted management. For example, our results indicate where areas of nutrient deficiencies are identified, productivity could be considerably increased through the reestablishment of biocrusts. Here we will present the results from this study with a model for its application to land management.