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Developing an Understanding of Vegetation Change and Fluvial Carbon Fluxes in Semi-Arid Environments

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Dryland environments are estimated to cover around 40% of the global land surface (Okin et al, 2009) and are home to approximately 2.5 billion people (Reynolds et al. 2007). Many of these areas have recently experienced extensive land degradation. One such area and the focus of this project is the semi-arid US Southwest, where degradation over the past 150 years has been characterised by the invasion of woody vegetation into grasslands.

Transition from grass to woody vegetation results in a change in ecosystem structure and function (Turnbull et al, 2008). Structural change is typically characterised by an increased heterogeneity of soil and vegetation resources, associated with reduced vegetation coverage and an increased vulnerability to soil erosion and the potential loss of key nutrients to adjacent fluvial systems. Such loss of resources may impact heavily upon the amount of carbon that is sequestered by these environments and the amount of carbon that is lost as the land becomes more degraded. Therefore, understanding these vegetation transitions is significant for sustainable land use and global biogeochemical cycling.

This project uses an ecohydrological approach, monitoring natural rainfall-runoff events over six bounded plots with different vegetation coverage. The experiment takes advantage of a natural abundance stable ^{13}C isotope shift from C_3 piñon-juniper (*Pinus edulis-Juniperus monosperma*) mixed stand through a C_4 pure-grass (*Bouteloua eriopoda)* to C_3 shrub (*Larrea tridentata*). Data collected quantify fluvial fluxes of sediment and associated soil organic matter and carbon that is lost from across the grass-to-shrub and grass-to-woodland transition (where change in space is taken to indicate a similar change through time). Results collected during the 2010 and 2011 monsoon seasons will be presented, illustrating that soil and carbon losses are greater as the ecosystem becomes more dominated by woody plants. Additionally this project utilises novel biogeochemical techniques, using stable ^{13}C isotope and lipid biomarker analyses, to trace and partition fluvial soil organic matter and carbon fluxes during these events. Results show that biomarkers specific to individual plant species can be used to define the provenance of carbon, quantifying whether more piñon or juniper derived carbon is mobilised from the upland plots, or whether more *Larrea tridentata* carbon is lost when compared to *Bouteloa eripoda* losses in the lowlands.

The combined approach of monitoring carbon fluxes and tracing types of carbon shows great promise for improved understanding of carbon dynamics in areas subject to rapid vegetation change.

References

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