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PATCHKEY: A PATCH CLASSIFICATION FRAMEWORK FOR THE UPPER BURDEKIN AND BEYOND

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ABSTRACT

In grazed landscapes, the condition, location, size and frequency of grazing induced patches can relate directly to hydrological function, sediment and nutrient loss at the paddock scale and beyond. A new patch classification framework (*PATCHKEY*) linking descriptors of the Queensland Department of Primary Industries and Fisheries (QDPI&F's) ABCD land condition framework with measurable drivers of hydrological function, has been developed to help quantify the processes of degradation and recovery on crusting soil types in the upper Burdekin region of North Queensland. *PATCHKEY* is being tested and refined using multivariate examination of measured patch attributes collected at a range of scales and sites. We are also using *PATCHKEY* to explore links between grazing preference and land condition at patch scale.

INTRODUCTION

In grazed landscapes of North Queensland, the condition, location, size and frequency of grazing induced patches can relate directly to hydrological function, sediment and nutrient loss, at the paddock scale and beyond. An essential tool to understanding these processes, and quantifying their hydrological impact, is a robust patch classification framework, which links structural elements of land condition with key drivers of landscape and hydrological function at the patch scale. This was the genesis of *PATCHKEY,* a conceptual patch classification framework, developed initially for use on the crusting soils of the upper Burdekin catchment.

DEVELOPMENT OF THE *PATCHKEY* CONCEPTUAL FRAMEWORK

PATCHKEY is a hierarchical patch classification framework (Figure 1) linking the main herbage layer descriptors and thresholds of the QDPI&F's, ABCD land condition framework (Chilcot et al, 2003) with key drivers of hydrological function selected from the array of soil surface condition assessment (SSC) attributes and thresholds of landscape function analysis (LFA) methodology (Tongway et al, 1995) The framework is deliberately independent of soil and, vegetation type, topography and short term grazing impacts, so that the interactions between patch condition, grazing preference and land type resilience can be explored.

The primary (structural) variables classify patches from A to D according to pasture condition, composition and ground cover thresholds; the secondary (functional) descriptors and thresholds (representing those elements of SSC considered to be most suited to use in rapid pass field assessment of patch types) determine the final *PATCHKEY* classification, signified by an alpha-numeric code e.g. A2, B3, C5. A subset of 26 *PATCHKEY* classes were selected for inclusion in the conceptual framework, representing the most likely combinations of primary and secondary attributes occurring from A to D condition. Of these, the largest number of *PATCHKEY* classes fell within the "C" condition category, which sits astride the Ecograze state and transition model "management restoration threshold" (Ash et al, 2001) and is the most dynamic in terms of structural and functional response to change.

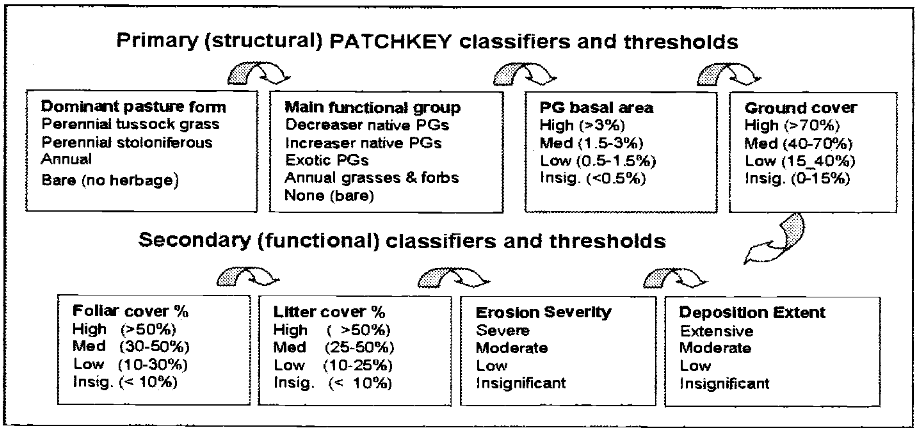

Figure 1: Diagram showing hierarchical flow of PATCHKEY patch classification framework

FIELD TESTING THE CONCEPTUAL *PATCHKEY* FRAMEWORK

PATCHKEY was tested at a range of scales and locations in the upper Burdekin during 2004-06. At each site a replicate series of patches was selected across the *PATCHKEY* range and independently profiled at contiguous 1m intervals along transects for the full array of pasture, soil surface condition (SSC) attributes. Mean SSC indices were derived for each patch type x site combination studied. This data was used to identify likely functional thresholds for more detailed profiling via direct measurement of infiltration, soil respiration, soil physical and chemical properties and leakiness. Data from the latter measurements were then used to derive relationships between SSC indices, ground cover and measured hydrological and soil health attributes, for application across the full *PATCHKEY* range. In addition, *PATCHKEY* classes were assigned to quadrat data collected for paddock scale pasture and grazing distribution surveys as part of the same project. This data provided a further resource for independent multivariate examination of the conceptual framework, while allowing interactions between grazing preference and patch condition to be explored.

Initial field test results

SSC stability, infiltration and nutrient cycling indices derived from patches showed a clear trend from A to D condition on all sites, but also variation within those condition classes, driven mainly by the relative contributions of foliar and litter cover and the extend of surface erosion and deposition present (Figure 2a). While there were some differences between land types (Figure 2b) in general SSC scores were comparable for given *PATCHKEY* classes.

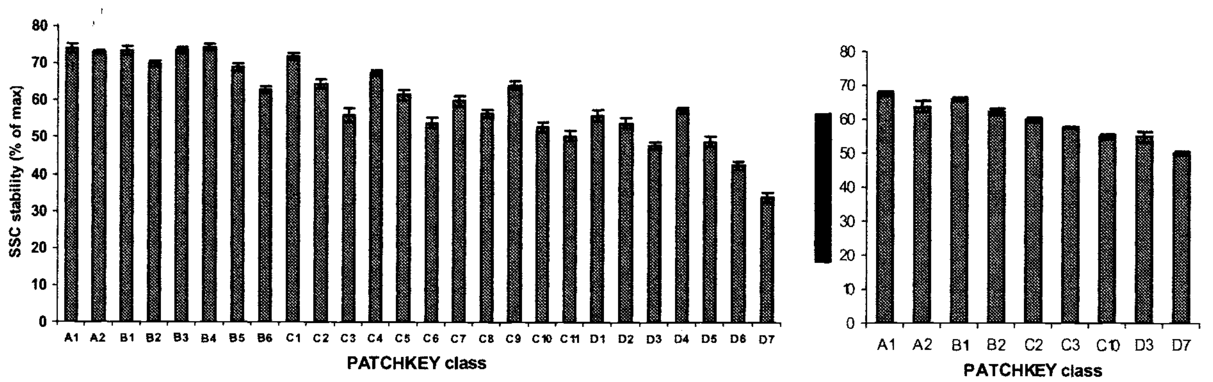

Figure 2a, b: LFA SSC scores for a. (left) a complete range of PATCHKEY classes at Virginia Park study site (red chromosols) and b. (right) a subset of patch types on at Wambiana study site (yellow sodosols).

If *PATCHKEY* pasture form and functional group categories are replaced by a single classifier denoting percentage contribution of decreaser perennial (3P) grasses, then class values (1-4 except for erosion/deposition where the order is 4-1) can replace *PATCHKEY* class levels (insignificant to high), allowing relationships between *PATCHKEY* "scores" and SSC indices to be developed. (Figure 3a). Relationships obtained between SSC values and measured patch attributes such as infiltration (Figure 3b), soil respiration and leakiness were then applied across the full range of *PATCHKEY* classes allowing development of predictive relationships between land condition, hydrological function and landscape health for the land types studied.

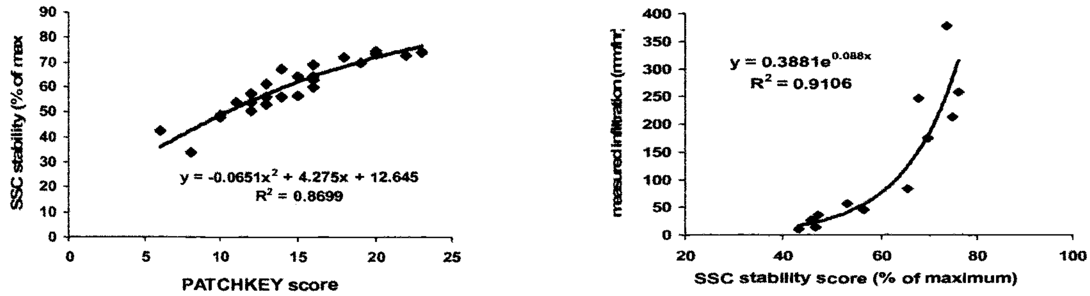

Figure 3 a&b: Relationships between a. SSC stability and *PATCHKEY* scores (left) and b. SSC stability vs. measured infiltration for key patches (right) at Virginia Park study site, November 2004

Our studies found some variation in the interaction between land type, patch condition and measured functional attributes, even within the crusting soil types, which may be due to inherent land type characteristics or historical land use impacts. This will be the subject of on-going investigation as *PATCHKEY* is tested and refined on a greater range of sites.

USING *PATCHKEY* TO EXPLORE THE INTERACTION OF GRAZING AND LAND CONDITION

Application of the *PATCHKEY* framework to grid surveys of pasture condition and grazing impacts on a range of study paddocks has allowed the interaction between patch condition and grazing preference to be explored, using the relative selectivity index of Jacobs (1974) $E = (Ui - Ai)/(Ui + Ai)$ where Ui is the proportion of total defoliation scores located on a given vegetation community and Ai is the proportion of total observations occupied by that vegetation community. The resultant value of E ranges from -1 to + 1, with a positive value indicating relative selection preference for that community (or other habitat feature) and a negative value indicating relative avoidance. Results indicate a clear preference for "C" condition patches in paddocks of low to moderate stocking rate and overall A-B condition (Figure 4a) with selection preferences flattening out as stocking pressure increases and paddocks move to towards C-D condition and available forage become limiting (Figure 4b).

WHERE TO FROM HERE WITH *PATCHKEY*?

The *PATCHKEY* framework is being refined, using both independent multivariate decision examination (cluster, Bayesian CART) of patch attribute data and conventional statistical techniques to determine the final *PATCHKEY* array, key thresholds and appropriate decision steps. In its present form *PATCHKEY* has already been successfully used to help develop relationships between patch condition, ground cover distribution and run-off at hillslope scale (Bartley et al, 2005).

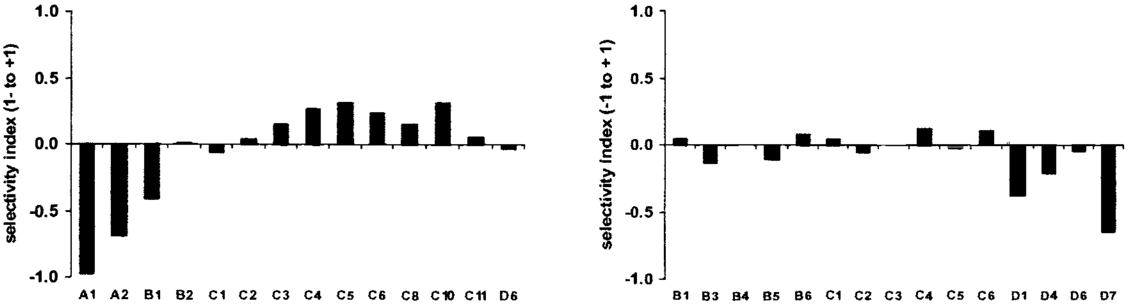

Figure 4a, b: Relative grazing selectivity for PATCHKEY types on a. Springs paddock, Blue Range Station - long term low stocked, B+ condition (left) and b. Bottom Aires paddock Virginia Park Station -long term high stocked, C condition (right) – end of dry season 2004

PATCHKEY has also been used to explore relationships between ABCD land condition and size, distribution and frequency of key patch types within the grazed landscapes of the upper Burdekin. Existing study paddocks at Virginia Park, Blue Range and Wambiana stations have been used to compare high resolution satellite imagery with ground based data, facilitating both classification into main *PATCHKEY* types and comparison with landscape leakiness indices ((Ludwig et al, 2002)) derived from the same imagery. Early results suggest that a refined *PATCHKEY* framework will prove to be a useful tool linking ground based monitoring of land condition with existing remote sensed monitoring tools.

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