



# 'Grass half full or grass half empty? Valuing native grassy landscapes'

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Friends of Grasslands Inc. (www.fog.org.au) supporting native grassy landscapes

## Multi-scale phenology of temperate grasslands

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The management of temperate grasslands will be an economic and ecological challenge under future climate scenarios. One approach to monitoring is by using time-series satellite data to characterise the vegetation dynamics, known as phenology. Characterising the phenology of grasslands through remote sensing is difficult because of their dynamic response to rainfall and typical high quantities of litter. In particular, scaling phenology from the satellite to species-level remains a challenge. In this project, we aim to compare satellite phenology-estimation methods with time-lapse camera ('phenocam') imagery and field data across different temperate grassland communities in and around the ACT. Through this we will identify the drivers of phenological fluctuations and determine how different scales affect phenology estimates. Results to date suggest that different grassland communities exhibit differences in phenology metrics, particularly maximum greenness values and timing of key events (e.g. peak greenness). Phenocam and satellite data tend to be related, though the greater frequency of phenocam data collection (daily) provides advantages. Field data on species phenophase is instrumental in explaining the variability and trends observed in the coarser scales. This approach provides a different perspective to remote grassland monitoring, and will be expanded to incorporate native grassland recovery.

Chris Watson graduated from the University of Sydney with a strong interest in botany. After working throughout Australia with environmental and botanical consultants he moved to Canada for a position with the Ontario Ministry of the Environment. He was coordinator of the Ontario Forest Biomonitoring Program which examined the long-term effects on maple forests, and established Ontario's first carbon flux monitoring system in the far north. Chris returned to Australia and is currently investigating grassland phenology as part of his PhD project with the University of Technology Sydney.

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### MULTI-SCALE PHENOLOGY OF TEMPERATE GRASSLANDS IN N.S.W. AND THE A.C.T.





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#### 1. INTRODUCTION

Management of temperate grasslands is critical for Australia's food security and biodiversity retention in the coming decades. Remote sensing is now commonly used for land management at a landscape scale, but grasslands present challenges to traditional remote sensing techniques. This is mostly due to their fast and dynamic response to climate drivers. Utilising the seasonal patterns of vegetation dynamics – or vegetative phenology – provides potential for remote sensing to monitor productivity and track grassland restoration over time. However the phenological response has only been explored in limited biomes within Australia<sup>2</sup>. Research is required to determine drivers of phenology in temperate grasslands, and to understand how phenology measurements scale from satellite to field-level<sup>3</sup>. This project aims to investigate phenological differences between temperate grassland types using multi-scale methods.

#### 2. METHODS


Twelve study sites were located in the southern highlands of NSW and the ACT. These represented relatively homogenous grassland of four types:



At each site, the following phenological methods were employed:


##### Field-level Data

- Monthly live/dead grass/herb biomass
- Monthly pasture height
- Monthly fractional cover measurement
- Monthly phenophase observations
- Monthly floristic data collection



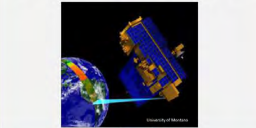
##### Near-surface Phenocam

- Hourly phenology (time-lapse) camera imagery converted to daily GCC greenness index<sup>4</sup>.

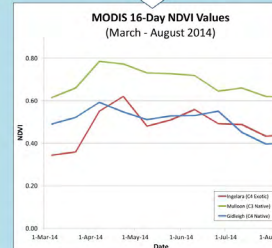
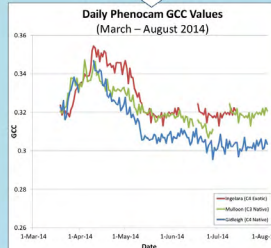
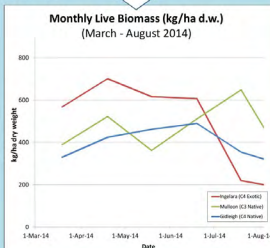
$$GCC = G/G+R+B$$


##### Landscape-level Satellite

- 16-day MODIS satellite data, processed to Normalized Difference Vegetation Index (NDVI)<sup>5</sup>, representing vegetation greenness.

$$NDVI = (\rho_{RED} - \rho_{NIR}) / (\rho_{RED} + \rho_{NIR})$$


#### 3. RESULTS



Results presented are examples of three site types between March and August 2014. Each method shows apparent greening in mid-April as a growth response to heavy autumn rains, followed by a general "browning down" through late autumn and winter. However, methods exhibited differences in the magnitude and timing of greening/browning responses. MODIS NDVI data showed a proportionally greater greenness for the C3 native site relative to the other methods, and a lower greenness for the C4 exotic site. Biomass measures at the native C3 site showed greenness peaks in winter that were less evident in the phenocam and satellite data. These differences are likely due to the impact of standing litter on the satellite signal, the differential contribution of grass and forb cover, and the different temporal resolution of each method.

#### 4. CONCLUSIONS

Different phenological methods show a general "greenness" trend agreement but the decreased temporal resolution of the collection method increases the coarseness of the result. Fixed time-lapse phenocams were found to indicate an accurate response to greening patterns in grasslands. Comparison between site types and method scales will be enhanced by analysis of phenology metrics at the completion of the annual cycle.

#### ACKNOWLEDGEMENTS

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