Spatiotemporal Impact Of Prescribed Fire Management On Land Cover Including Biocrusts

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Introduction

- In the Australian rangelands, prescribed fire is used as a tool to manage the vegetation density and regeneration (Cowley et al., 2014). However, fire impacts the biodiversity including biocrusts which serve several ecosystems including reduction on soil erosion and nutrient replenishment (Williams et al., 2022).
- It is important to monitor biocrust cover to assess ecosystem health and guide sustainable land management practices.
- Remote sensing provides a potential tool for monitoring different land covers including biocrusts.

Aims

- In this research, we investigated the impact of prescribed fire management on temporal dynamics of landcover including biocrusts.
- The objective of this study was to determine the ability of spatiotemporal high resolution remote sensing to estimate changes in land cover.

Methods

- The study was conducted at the Fire-grazed research site (2.6 km²) at Victoria River Research Station (VRRS), Northern Territory, which was burnt in October 2022.
- We used PlanetScope images with a spatial resolution of 3 m to monitor the landcover changes of biocrusts from July 2022 to June 2023 (Image © 2023 Planet labs PBC) (https://api.planet.com).
- There were four study periods: Pre-burning dry season (Jul-Sep 2022), Post-burning early wet season (Oct-Dec 2022), Post-burning wet season (Jan-Mar 2023), and Post-burning dry season (Apr-Jun 2023).
- We collected reference data from different ground covers, including bare degraded soil, biocrusts, grass, and trees/shrubs.
- Crust Index (CI) (Karnieli, 1997) was applied to discriminate biocrusts from other landcovers, bare soil, and vegetation.
- Training data consisted of 75% ground truth data and 25% validation data were applied for land cover classification. A Random Tree classifier was applied for the classification of land cover attributes.
- Accuracy assessment was implemented using Kappa's confusion matrix.

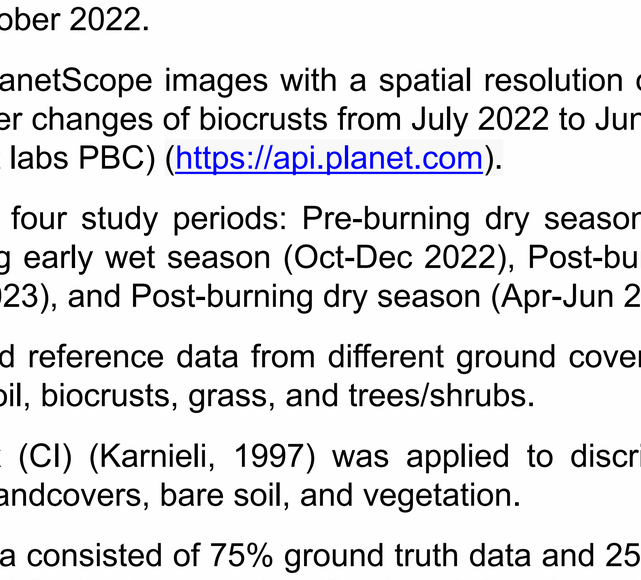

Figure 1. Training polygons for Ground Cover Classes, Bare Soil, Biocrusts, Grass and Trees/shrubs in Fire-Grazed Area

Results

- The overall accuracy of Cohen's Kappa confusion matrix was 90 % accuracy in identifying land cover classes, bare soil, biocrusts, grass and trees, across multiple time points.
- Post-fire, early wet season, biocrust cover decreased by 10.8%, from 67 ha pre-burn to 39 ha.
- An increase of 10% in vegetation cover (189 ha to 215 ha).
- Bare soil areas expanded by 20%, from 7.9 ha to 9.7 ha.

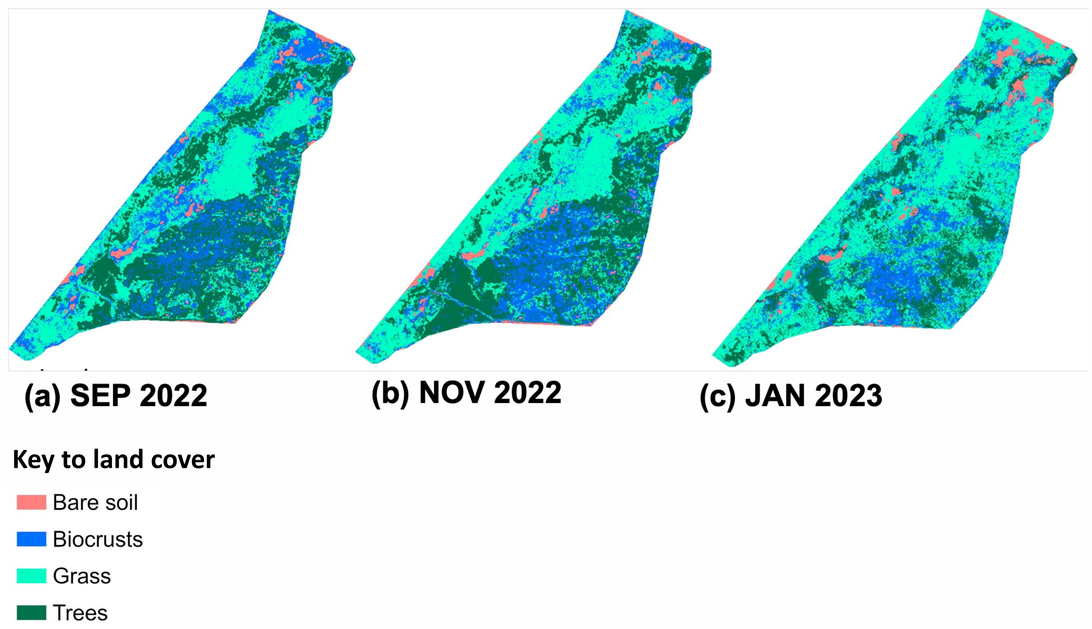

Figure 2. Land cover changes (a) Pre-fire dry season, and (b) post fire early wet season – near green date (c) Post-fire wet season – after green date

Outcomes

- This study enhanced our understanding of impact of burning management strategies on rangeland.
- We developed sensing metrics for accurately estimating biocrust cover after fire and its recovery after the wet season.
- Grass canopies had obscured the biocrusts underneath them.
- Expansion of bare soil was likely due to cattle trampling.
- In summary, these results underscore the value of using high resolution remote sensing for assessing and managing land cover dynamics that includes biocrusts in rangeland ecosystems.

References

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