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Interactive comment on "Cyanobacterial species richness and *Nostoc* highly correlated to seasonal N enrichment in the northern Australian savannah" *by* Wendy Williams et al.

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Overall We thank all referees for providing their time and recognising the importance of this research that focuses on the critical role of cyanobacteria within biocrust communities and their contribution to soil nutrients, especially N-fixation.

We appreciate the constructive comments for improvements to the manuscript and have addressed each one below. Referee 2 R2: The manuscript can be improved by shortening the abstract and conclusion. Response: The abstract has been reduced from 330 words to 255 words: 'Abstract Boodjamulla National Park research station is situated in north-west Queensland dry savannah where the climate is dominated by summer monsoons and virtually dry winters. Cyanobacterial crusts almost entirely cover the flood plain soil surfaces in between the tussock grasses. Seasonality drives N-fixation and in the savannah, this has a large impact on both plant and soil function. Many cyanobacteria fix dinitrogen that is liberated into the soil in both inorganic and organic N forms. We examined cyanobacterial species richness and bioavailable N spanning seven months of a typical wet season. Over the wet season cyanobacterial richness ranged from 6–19 species. N-fixing Scytonema accounted for seasonal averages between 51–93% of the biocrust. Cyanobacterial richness was highly correlated with N-fixation and bioavailable N in 0-1 cm. Key N-fixing species such as Nostoc, Symploca and Gloeocapsa significantly enriched soil N although Nostoc was the most influential. Total seasonal N fixation by cyanobacteria demonstrated the variability in productivity according to the number of wet days as well as the follow-on days where the soil retained adequate moisture. Based on total active days per month we estimated that N-soil enrichment via cyanobacteria would be $\sim$ 5.2 kg ha-1 annually which is comparable to global averages. This is a substantial contribution to the nutrient deficient savannah soils that are almost entirely reliant on the wet season for microbial turnover of organic matter. Such well-defined seasonal trends and synchronisation in cyanobacterial species richness, N-fixation, bioavailable N and C fixation (this journal) provide important contributions to multi-functional microprocesses and soil fertility.' The second paragraph from the conclusion has been removed (also see comments from R3)

R2: "Minor comments 2.3.4 Statistics: Please indicate what method you used for linear regression." Response: Statistics section now has this information included: 'We used linear regression models to examine potential relationships between bioavailable N and cyanobacterial richness separately, for N-fixing and non-N-fixing cyanobacteria (see Table 1). We examined differences in bioavailable N between the two depths across time with mixed-models ANOVA. Our model had two strata, one that accounted for the differences among the nine time periods, and a second stratum accounting for depth and its interaction with time. All of these analyses were run in Minitab Version 16.1.0

(2010). Least Significant Difference (LSD) testing was used to examine differences in means among the nine time periods. Tests for homogeneity of variance, independence and normality in the data, using Levene's test and other diagnostic tools in the Minitab (2010) statistical package, indicated that no transformations were necessary.'

R2: P7, L8: "Here the bioavailable N consisted NH4+ and NO3-, so how about dissolved organic N in soils?" Response: We did not fractionate the forms of N therefore did not measure DON however with the 2M KCL hot extraction it is possible that some DON could be converted and in this case the measurement would include that. The primary focus for this project was to understand bioavailable N that may have entered the system via cyanobacteria.

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