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Diminution of soil carbon sequestration following 72 years grazing disturbance; a study of cyanobacterial soil crusts from the Australian Mulga Lands

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Cyanobacterial crusts are important components of arid and semi-arid soils and can be used to gauge soil function. Cyanobacterial soil crusts cover an average of 28% of the soils across Glencoban research site, a 2000 Ha paddock in south-western Queensland. For 72 years domestic stock water had been supplied by 6 km of open-earth, continuously flowing bore drains. This had resulted in significant degradation of cyanobacterial crusts within 200 m distance of the drains. This study commenced seven years after the closure of the bore drain and the installation of five watering points. With no remnant sites available changes in cyanobacterial crust recovery were examined for cover, diversity and net productivity along 500 m transects extending out from the bore drain. CO_2 gas exchange measurements were conducted under controlled laboratory conditions in a mini-cuvette system (Walz).

It was found that there were no longer any significant disturbance gradients evident in the cyanobacterial crusts; however, there was a clear threshold around 100 m from the bore drain where the composition of the crust taxa changed significantly. Cyanobacteria accounted for more than half the differences indicating a time-altered compositional state compared with the broader paddock.

Crust samples taken from distances >200 m from the bore drain reached almost twice the rates of net photosynthesis compared with crusts sampled at distances <100 m, which were also depressed by over-saturation of water sooner. Productivity of these crusts peaked at 37oC with CO_2 uptake responses of crusts from both zones similar with regard to light intensity and temperature; however they differed in water uptake requirements. These results demonstrated that differences in crust composition as a result of long-term disturbance may also impact on soil carbon sequestration through a reduction in net primary productivity.