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Apparent dryland salinity on the Australian uplands: causes, mechanisms, effects, mapping and management.

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Primary dryland salinity is a recognized worldwide phenomenon. Secondary dryland salinity has been a major environmental concern in Australia for a number of decades and indeed other regions of the world, including South Africa. However, in Australia, aspects concerning its cause, the mechanisms that drive it and its effects, remain controversial. Dryland salinity has been almost universally attributed to rising saline groundwater, caused by excess water accumulation in the landscape following European settlement and tree clearing, the Rising Groundwater Model (RGM). However, there is much evidence that instead suggests that increased soil salinisation is attributable to localized surface water changes associated with soil and vegetation degradation, or a surface water model. This research investigates the effects of soil and vegetation degradation and associated elevated salinity levels on soil abiotic and biotic parameters. This was then used to construct the most relevant model for upland dryland salinity occurrences. Field research was conducted in box/gum grassy woodlands in the agricultural zone of SE NSW, with examples from Victoria and South Australia. A holistic suite of metrics, including soil physical, chemical, hydrological and biological attributes, were assessed in the field and laboratory; geophysical surveys (EM31/EM38) and various fauna and flora surveys were performed. Results indicated that degraded soil surfaces with elevated salinities were often small in area and localized, with surfaces highly variable in soil EC levels (often very low), and were associated with *in situ* synergistic factors related to *in situ* soil and vegetation degradation. Some surfaces had accumulated NaCl, but many also had other, both toxic and low cation and anion levels, particularly reduced levels of Ca, Fe, N, SOM and SOC. Extreme pH levels and other soil physical, chemical and biological impacts were also common. It is concluded that elevated soil salinity levels are a symptom of soil and vegetation degradation, not the cause. It was found that the predominant water movement in these landscapes occurred as overland runoff and surficial lateral interflow above the clay-dominant B horizon. There was no biological, pedological, geophysical or hydrological evidence of groundwater being a major factor for elevated soil surface salinity levels at these upland sites. Evidence suggests that these degraded ecosystems are relatively stable but urgently require nutrient/SOM input. Many endemic fauna and flora species flourish at highly degraded and salinised sites; tolerating elevated and fluctuating salinity levels, at all life cycle stages. Management decisions based on reducing the soil surface evaporation potential on site is the most coherent approach. Management activities should focus on stock grazing exclusion, soil amelioration and revegetation activities using endemic species, rather than focusing on excess deep landscape water management with hybrids and exotic plants. The present use of AEM for mapping

dryland salinity in upland environments is therefore questionable. Applications will be mentioned for other regions in other countries where dryland salinity occurs.