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Vegetation response to watering regime in Australian dryland wetlands: resilience and thresholds

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A gradient from dry to aquatic conditions determines the establishment and succession of plant communities common to Australian dryland wetlands. However, the vegetation distribution does not strictly follow a gradient pattern, but more of a mosaic-like distribution. This is partially related to the specific topographic conditions of the site that dictate the water regime, but it is also strongly related to previous vegetation in the area, conditions for succession and critical thresholds for water requirements. Wetland vegetation species have critical frequencies of inundation of several years and they are very persistent. Some species can maintain a seedbank for years and others can recover after many years without flooding due to rhizome banks in the soil. This means that successions can be delayed or not even occur even if watering requirements are not met. Successions would also depend on previous history and surrounding vegetation groups that are able to colonize. Forests and woodlands are more resilient to long periods without flooding, but they do require to be healthy in order to produce seeds which means that after a dry period a sequence of floods is required for regeneration. All these flow-vegetation interactions create a shift in the gradient that results in some vegetation species either succeeding or remaining in a certain state, which originates a more grouped or mosaic-like vegetation distribution as mapped in real sites.
We combine theoretical water requirements of vegetation in terms of inundation frequency, duration and depth, local water conditions obtained with hydrodynamic modelling and real vegetation health conditions in a wetland to determine rules that can drive vegetation succession. We select six different vegetation patches including transitional and non-transitional patches on the main vegetation types, as assessed from historical data on a dryland wetland in Australia. We use seasonal fractional cover maps to asses vegetation health, and we show that vegetation resilience and thresholds for succession can be captured in terms of percentage of area of the patch that receive the theoretical water requirements. We discuss the implications of our approach for modelling vegetation evolution in dryland wetlands.