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Thesis abstract

Environmental flows at work; restoring floodplain wetlands through return of historical conditions

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Wetlands are among the most degraded ecosystems worldwide, demanding effective restoration. In an effort to ameliorate ecological degradation from upstream water diversions, environmental and managed flows are increasingly used to help restore vegetation communities. Understanding of factors affecting the success and efficacy, however, remains limited and is of increasing urgency as this type of restoration becomes more widespread. I investigated the capacity of flooding, including environmental flows, to restore wetland flora across areas varying in degradation from historic land-use.

I predicted that increasing land-use history (increasing duration and decreasing time since land use) would decrease restoration effectiveness, while increased flooding frequency and duration should improve restoration outcomes. A case study was used to assess vegetation restoration: a floodplain wetland with fields representing a land-use chronosequence, flooded through environmental flows, in the Macquarie Marshes in the Murray-Darling Basin of south-eastern Australia. I examined extant vegetation, soil seedbanks, plant trait distributions and historical vegetation change through surveys of plant community composition, greenhouse seed bank germination, fourth-corner trait modelling approaches and Landsat imagery analysis.

Composition of extant herbaceous vegetation correlated with both land-use history and flooding, while extant shrub and woody species were more strongly correlated with land-use. Within seedbanks, exotic and disturbance-adapted species were associated with increased duration and decreased time since land-use and native wetland species were associated with opposite land-use practice and increased flooding. Furthermore, I found that there was capacity within the soil seed bank to engender further restoration of extant vegetation. Trait analyses showed native, woody and clonal species were taking the longest to restore, especially in high land use areas, but this may be ameliorated through increased inundation. Landsat analyses demonstrated that inundation was vital to restoration and also indicated a gradient of restoration success, with areas of less land use history (e.g. clearing and one year of cultivation) restoring more quickly than longer cultivation durations. In conclusion, flooding was critical to achieving restoration objectives, with higher frequencies increasing efficacy, but increased land-use intensity compromises restoration rates and possibly success.

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