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THE INFLUENCE OF WATER REGIME ON THE
FLORISTIC COMPOSITION OF LOWER RIVER
MURRAY WETLANDS

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EXECUTIVE SUMMARY

This thesis examines the influence of ‘water regime’, or spatial and temporal patterns in the presence of water, on the floristic composition of wetlands on the River Murray in South Australia (henceforth Lower Murray). It explores the hypothesis that the composition of wetland vegetation is determined by components of the water regime, namely depth, duration and the rate and timing of flood and drawdown. This was tested by examining the influence of water regime variations on:

1) floristic composition in individual wetlands;
2) regeneration (establishment, growth, reproduction) and extirpation of species; and
3) morphological and physiological responses of species.

Two field studies and one controlled pond experiment were undertaken. In the first field study, four wetlands characterised by managed flood and drawdown and two unmanaged, permanently inundated wetlands were monitored between October 1999 and March 2001. Periodic flood and drawdown significantly changed the vegetation in the managed wetlands, whereas plants in the permanently inundated wetlands did not respond. Floristic differences between these wetlands increased as the managed wetlands were drawn down, but converged after re-filling. As a result, water regime management over this 18-month period did not consistently promote more diverse or unique florals.

The establishment and extirpation of species indicated responses to flood and drawdown governed by a) the depth, duration, timing and rate of flood and drawdown, b) the prior vegetation, as influenced by c) previous flood and drawdown events. Changes were greatest in the initial 1-3 months of flooding because of extirpation of mudflat annuals such as Centipeda cunninghamii (common sneezeweed, Asteraceae), Persicaria lapathifolia (pale knotweed, Polygonaceae) and Rorippa palustris (marsh watercress, Brassicaceae) and establishment of the submerged macrophyte Vallisneria americana (ribbonweed, Hydrocharitaceae) and emergent macrophyte Typha domingensis (cumbungi, Typhaceae).

A model was developed to predict the presence/absence of species and functional groups. It incorporates water regimes of 3, 4, 5 and 6 months duration and estimated preferences for species and functional groups in a permanently inundated Lower
Murray wetland. Predictions for species were more accurate (76-86%) than for functional groups (64-74%). Predictions were more successful as the duration of hydrograph increased because fewer predictions were made of annuals, which tolerated < 100 days of flood or drawdown. Water regime preferences proved useful for predicting the presence and absence of Lower Murray wetland plants in permanently inundated wetlands where perennial are dominant.

The second field study examined the influence of manipulated water regimes on floristic composition at sites inundated during an enhanced flood in October 2000. Vegetation at three sites was surveyed before and after the flood. Among 32 recorded species, *Atriplex vesicaria* (bladder saltbush, Chenopodiaceae), *Sporobolus mitchelli* (sedge tail couch, Graminaceae) and *Sarcocornia quinqueflora* (samphire, Chenopodiaceae) accounted for 82% of the total cover/abundance. Vegetation changes across the floodplain were due to the growth and germination of flood-tolerant and flood-dependent species (e.g. *S. mitchelli*) and the senescence of flood-insolent species (e.g. *A. vesicaria*). No aquatic plants germinated or established, despite favourable conditions, suggesting an impoverished seed bank or heavy grazing by native herbivores.

Examination of *S. mitchelli* and the perennial shrub *Muhioboeckia florulenta* (tangled ligrum, Polygonaceae) revealed that vegetative growth was the most significant response to floodplain inundation. However, these responses were not strictly aligned with elevation suggesting a non-uniform response to flooding.

Morphological and physiological responses underlying vegetation change were examined through a pond experiment. Four common emergent macrophytes - *Bolboschoenus caldwellii* (three-cornered rush, Cyperaceae), *Cyperus gymnocalotus* (spiny sedge, Cyperaceae), *Juncus articulata* (nussock rush, Juncaceae) and * Schoenoplectus validus* (river club rush, Cyperaceae) were subject to regimes of slow (1 cm d⁻¹) and rapid (5 cm d⁻¹), shallow (20 cm) and deep (60 cm) flood and drawdown. Relative growth rate was correlated with emergent photosynthetic area and root mass for all species. Culm extension enabled *B. caldwellii* and *S. validus* to maintain emergent photosynthetic area when flooded and thus growth. Similarly, root extension was a feature of these plants that maintained growth when exposed to drawdown. These responses were most pronounced when plants were subject to rapid, deep flood and drawdown. Combined with the ability to extend roots, the timing and
magnitude of stomatal conductance changes suggest that *C. gymnocaules* and *J. aridicola* may be better suited to periodic drawdown.

Optimal growth rates led to optimal investment in asexual reproduction for all bar *S. validus*, which decreased culm production despite maintenance of growth when flooded. *B. caldwellii* maintained numerical increase when slow deep flooded by reducing the proportional allocation of biomass to tubers, whereas *S. validus* sacrificed numerical increase to retain investment in rhizomes. The latter response was observed for both species when exposed to deep drawdown. No trade-off was evident between asexual and sexual reproduction for any of the study species.

The pond experiment suggests that tolerance of drawdown requires specific morphological and physiological strategies in the same way that flooding does. A further conclusion is that strategies for responding to drawdown are equally as important as strategies for responding to flooding in determining the distribution of emergent macrophytes across the littoral zone of wetlands.