Littoral Ecology of a Regulated Dryland River (River Murray, South Australia) with Reference to the Gastropoda

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Abstract

The riverine littoral zone is a boundary between terrestrial and lotic aquatic ecosystems, corresponding to the "wetted perimeter" when the river is within its banks and the advancing or receding water's edge in times of flood. It is a patchy habitat whose spatial complexity reflects the geomorphological nature of the floodplain, and whose temporal complexity is related to variations in the timing and duration of floods.

Flow regulation modifies the scale of littoral habitat patches. Spatially, it decreases lateral gradients and enhances longitudinal gradients, alienating channel and floodplain habitats. Temporally, it may reduce the frequency, amplitude and duration of floods, or increase the frequency of short-term water-level fluctuations. Such changes are apparent in the River Murray, a regulated dryland river in south-eastern Australia. The regulated regime in the lower Murray is governed by a series of 10 weirs, and is distinguished by increases in summer-autumn flows, long-term flow constancy and short-term flow fluctuations.

This thesis explores the ecological impacts of regulation on the littoral zone of the lower Murray, South Australia. It first describes the spatial patterns of benthic macroinvertebrate assemblages at macro-, meso- and micro-scales. Particular attention is given to the gastropod fauna, a group likely to be sensitive to changes in the littoral environment, and one of the few groups for which there are some, albeit sparse, historical data.

In summer 1990, littoral habitats of the lower Darling and lower Murray rivers supported 103 macroinvertebrate taxa, dominated by insects and crustaceans, but with uneven distributions of individuals among taxa. In each river there was a wide diversity of meso- and micro-habitats. Distinctive assemblages were apparent across the entire range of spatial scale in each river, and the complexity of microhabitats influenced patterns at meso- and macro-scales. The relative abundances of "functional feeding groups" in all habitats indicated utilisation of diverse resources of organic detritus. Generalist *collector-gatherers* were commonest, with few *filterers* and *scrapers*; suggesting that organic matter inputs in these lowland reaches come principally from the floodplain rather than from downstream transport.

Regulation may diminish lateral water-level changes and impose strong longitudinal gradients on the littoral zone. The weirs on the lower Murray impose sequential water-level and trophic gradients, and disrupt the distribution of vegetation. These gradients are reflected in the invertebrate assemblages of the upper, middle and lower weir pools. In all littoral pool environments snags (fallen wood) and emergent macrophytes are common, and invertebrate assemblages include highly abundant shrimps, chironomids and other taxa. In the upper pools submerged macrophytes are common, with assemblages containing amphipods and coleopterans. In lower pools unvegetated reaches and sedge microhabitats predominate, each with distinctive invertebrate assemblages dominated by dipterans.

The biology of the prosobranch gastropods were therefore examined to determine the reasons for the virtual local extinction of some 18 species over the past 30-40 years.

Increases in the rate and magnitude of daily or weekly water-level fluctuations may have contributed by stranding snails when levels fall suddenly. Experiments showed, however, that *Notopala hanleyi* and *Thiara balonnensis* were able to accommodate to fluctuations even greater than those that normally occur in the regulated river. Decreased seasonal fluctuations may have contributed to the decline by changing available food sources. Both *Notopala* and *Thiara* are detritivores, assimilating carbon from detrital sources even when algae are abundant. They are also viviparous, requiring an abundant supply of nitrogen for breeding and growth, particularly for females. Compared with algal periphyton, microbial biofilms have a high food quality, measured as the ratio of carbon to nitrogen (C:N). *Notopala* is unable to select detritus in the presence of abundant filamentous algae. Thus, if faced with a food resource consisting entirely of algae, these species may be unable to obtain sufficient nitrogen. This is supported by the persistence of snail populations in environments where food resources are rich in nitrogen, notably the irrigation pipelines of the Riverland in South Australia.

Algal biofilms are prevalent in all pool environments associated with the lower Murray, but this may not have always been so. Regulation has stabilised the photic zone and enhanced the growth of attached algae, whereas in unregulated, turbid rivers, as the Murray was prior to about 1920, the constant movement of the water levels causes the photic zone also to move constantly, preventing prolific algal growth. In unregulated rivers, the community is likely to be predominantly heterotrophic (bacterial/microbial). A shift from bacterial-microbial towards algal food sources in the Murray may have affected many aquatic invertebrate species, including the gastropods.