The impact of Lippia on the social-ecological systems of the Gwydir Wetlands, and Macquarie Marshes in northern NSW

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Abstract

The Murray-Darling Basin is a Social-Ecological System (SES) of major importance to Australia and includes extensive wetland areas in the north western parts of New South Wales. Historical land use has been extensive grazing; during wet periods the livestock were moved out of the wetlands and moved back in as the water receded. Recent land use changes include the building of major dams for irrigation water, and this has meant a reduction in the frequency and extent of flooding, and most of the wetlands have been continually grazed. Also, machinery capable of cultivating the very heavy textured soils became available and so dryland cropping became a major enterprise. With the reduction in flooding, many of these wetland sites have been seriously degraded. In recent years lippia, *Phyla canescens* (Kunth) Greene has had major impacts on parts of this SES. Lippia is a perennial that grows mat-like between other species of plants and may spread to produce virtually a mono-specific stand. The domestic livestock carrying capacity of the land becomes more or less zero and the conservation value of the wetlands is also dramatically decreased. Therefore, invasion of these wetlands by lippia has had and will continue to have, a major impact on the future trajectory of the whole SES in terms of its resilience, adaptability and transformability.

Introduction

The Murray-Darling Basin (MDB) is a Social-Ecological System (SES) (Walker *et al*. 2004) of major importance to Australia and is one of Australia's largest lowland river systems (Thoms and Sheldon 2000). Lowland river systems typically originate in relatively wet upland regions but flow for most of their length through semi-arid to arid landscapes. Characteristic features of such rivers are their broad floodplains, low relief and low flow rates, and systems of anabranched channels and wetlands at intervals along their length (Walker *et al*. 1995; Thoms and Sheldon 2000). Compared with such river systems around the world, the Australian lowland rivers have a much larger temporal variation in their flow and this variation impacts on all aspects of the SES (Walker *et al*. 1995). Two systems of anabranched channels and wetlands in the MDB are the Gwydir Wetlands west of Moree and the Macquarie Marshes north west of Coonamble.

There are three attributes of SESs that determine their trajectories over time: resilience, adaptability and transformability (Walker *et al.* 2004). Resilience is the capacity of a system to absorb disturbance and still retain essentially the same structure, function, identity and feedbacks while undergoing change. Adaptability is the capacity of the actors in an SES to manage it and so influence its resilience (Walker *et al.* 2004). Finally, transformability is the capacity to create a fundamentally new system when economic, social or ecological changes make the system untenable.

Phase 1 - Europeans first encounter the Indigenous Australians SES

Surveyor-General John Oxley was convinced that the western-flowing rivers ended in an inland sea and followed the Macquarie down to the Macquarie Marshes during the wet winter of 1818. There they lost the river in a sea of reeds and headed for the coast at Port Macquarie (Johnson 2001).

Captain Charles Sturt also followed the Macquarie down to the marshes during a "fearful" drought in 1828. The Macquarie had stopped flowing and finding water in the marshes and surrounding stream beds was a major problem (Sturt 1833). They skirted the marshes and

encountered the Darling, which had also stopped flowing and was too salty for either them or their livestock to drink. These extremes in water availability governed the SESs in the Gwydir Wetlands and the Macquarie Marshes developed by the indigenous inhabitants (Fig. 1).

Phase 2 - the SES developed by the early settlers

The first settlers in the western regions of NSW drove their livestock overland and settled wherever there was permanent water, some of them close to the Darling River and the nearby wetlands. The improvements in communication during the latter half of the 19th Century were also accompanied by the discovery of the artesian basin and the development of the technology to access the water by drilling (Pittman 1914). The result was closer settlement which came to an abrupt halt with the 1889–1902 drought (Fig. 1). So devastating were the results of this drought and the ecological changes in the landscape, that a Royal Commission was held in 1901 (NSW Legislative and Assembly 1901) followed by the Western Lands Act (New South Wales 1901).

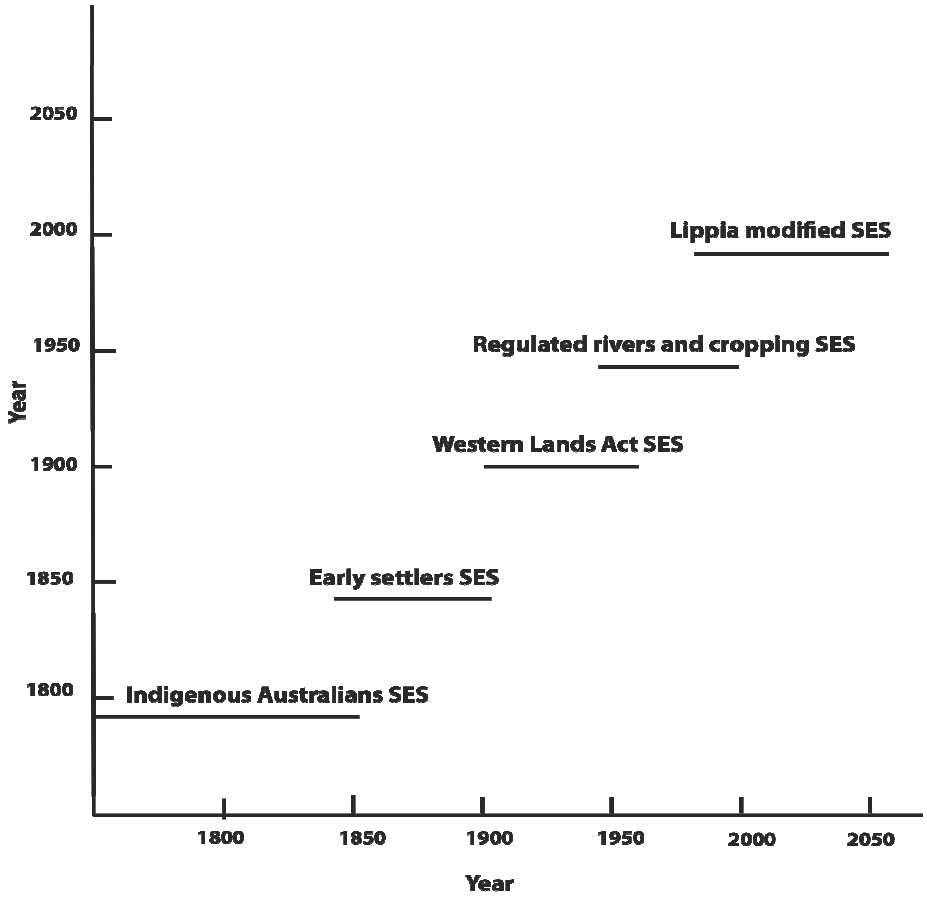

Fig. 1. Timelines of the major influences on the social-ecological systems (SESs) of the Gwydir Wetlands and the Macquarie Marshes since before European settlement to the present. Major transformations of each SES occurred at the end of each timeline. The position of each timeline on the Y-axis is determined by its approximate start (except for the Indigenous Australians SES).

Phase 3 - the SES under the Western Lands Act

The changes brought about by the Western Lands Act and the lessons learnt from the major drought, meant that a more or less stable SES prevailed until the 1950s (Fig. 1). The usual patterns of droughts and floods continued and both sets of wetlands were grazed, with livestock moving further into the wetlands during droughts and retreating to higher ground with the periodic floods.

Phase 4 - regulated rivers and cropping SES

Two more major changes occurred about the middle of the 20th Century which dramatically altered the SESs in the MDB as a whole and particularly in the Gwydir Wetlands and the Macquarie Marshes. The first was the development of high-powered tractors in the 1950s followed by large areas of cropping on the heavy soils of the flood plain.

The second was the construction of the large dams in the uplands on the western and southern flowing tributaries in northern NSW and southern Queensland. Associated with these dams, were the granting of irrigation licenses on the flood plains together with large on-farm water storages. The extensive flooding of the Gwydir Wetlands and the Macquarie Marshes ceased towards the end of the 20th Century (Fig. 1).

Phase 5 - lippia invasion and the wetland SESs

The most recent transformational change has been invasion by *Phyla canescens* (Kunth) Greene, a native of South America that was originally deliberately introduced into Queensland in the 1920s, becoming widespread in the MDB from about the early 1990s (Fig. 1).

Once well established, lippia forms a more or less monospecific stand and the herbaceous plant biodiversity is markedly reduced. The habitat for small native animals is dramatically altered and the available forage for herbivores (both native and domestic) becomes virtually non-existent. The livestock carrying capacity of the land becomes but a fraction of the original (Earl 2003; Crawford 2008). The invasion by this weed produces a major transformation of the SES in the wetlands to a new, stable, lippia-dominated state. The only presently effective way of altering this state is by cropping for several years followed by sowing of introduced pasture grasses (Crawford 2008). This pressure for the further spread of cropping in the environmentally sensitive Gwydir Wetlands and Macquarie Marshes has major conservation implications (Crawford 2008).

Adaptability

The case studies described in Crawford (2008) clearly illustrate that many land managers within the lippia-invaded wetlands of the upper MDB are thinking creatively about how to reduce the dominance of lippia in the wetlands under their control. It is clear that the precariousness of an SES in which lippia is present but not dominant is high (Walker *et al*. 2004) in that such a system is likely to cross the threshold to lippia dominance.

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