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Integrated valuation of ecosystem services obtained from restoring water to the environment in a major regulated river basin

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ABSTRACT

Evaluating different environmental policy options requires extensive modelling of biophysical processes and attributes linked with metrics to measure the magnitude and distribution of societal impacts. An integrated ecosystem services assessment (IESA) has potential to provide salient, credible and legitimate information for environmental policy- and decision-makers. Here we present results of an IESA of the Murray-Darling Basin Plan, an Australian Government initiative to restore aspects of river flow regimes to improve the ecological condition of floodplains, rivers and wetlands in south-eastern Australia. The main outcome from the IESA is that the supply of most ecosystem services (ES) improves under Basin Plan policy and that these improvements have considerable monetary value. An IESA can provide actionable ecological, economic and social information for policy- and decision-makers. In the Basin Plan case the IESA was underpinned by hydrological scenarios that were input into ecological models and inter-disciplinary integration across scales, values and variables.

1. Introduction

Ecosystem service (ES) assessments are an integrated approach that links the condition of ecosystems with the provision of benefits from those ecosystems and the contribution of those benefits to human wellbeing. There are practical lessons from the application of these approaches: ES assessments can identify the many values nature provides to society (MEA, 2005) and these values can be incorporated into decision-making (Fisher et al., 2008), for example, in the context of land-use planning (Bateman et al., 2013), biodiversity conservation (Nelson et al., 2009), water management (Keeler et al., 2012) and infrastructure investments (Crossman et al., 2010). Ideally an ES assessment provides salient, credible and legitimate information (Cash et al., 2003) on the benefits associated with natural resources, and their management, over and above standard policy assessment tools such as benefit cost analysis (BCA).

Operationalising the ES framework involves the provision of useful evidence on the benefits received from ecosystems (Fisher et al., 2008; Daily et al., 2009). ES assessments typically consist of global or national assessments of the stock of natural capital and the flow of ES (Costanza et al., 1997; MEA, 2005; TEEB, 2010; UK NEA, 2011), or analyses of how ES flows are likely to change under different policy options: so-called "programme evaluation" (Nelson et al., 2009; Bateman et al., 2011). Both types of ES assessment require interdisciplinary, integrated research that links ecosystem processes and functions to the supply of ES and then to human wellbeing (de Groot et al., 2010). Integration is complex because ecological and social systems each have their own spatio-temporal and self-organising dynamics (Levin, 1998; Liu et al., 2007) and embody a plurality of values, some of which can conflict.

An ES assessment may assist in decision-making, context setting and accountability in contested settings (Trabucchi et al., 2012). In its simplest form, an ES assessment compares intervention against a "business-as-usual" scenario, or comparisons of policy options. Superficially the worthwhile investment and comparison of alternatives criteria matches a BCA. However, ES assessments also require an understanding of the type, magnitude,

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supply, timing and distribution of ES and the consequences of changes in ecosystem condition, functions and resilience (Folke et al., 2004; Mäler et al., 2008). In this way, it provides more comprehensive information, for example, on whether the benefits to society from preventing and reversing decline of natural ecosystems and ecosystem functions, exceed the societal costs (Balmford et al., 2011).

In this paper we reflect on an integrated ES assessment (IESA) completed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO, 2012) of the Murray-Darling Basin Plan (Commonwealth, 2012; hereafter, 'the Basin Plan'), a multi-jurisdictional water sharing initiative intended to address over-allocation of water resources for irrigation and other consumptive uses in a major drainage basin in south-eastern Australia. The paper proceeds with a description of the case study, the methods used and results including updates of the integrated biophysical-economic valuation and tools we developed to better support decision making. We end with a discussion on how an IESA can provide additional credibility, legitimacy and saliency for decision support and on the operational challenges of integrating different values in actual programme assessments.

2. Case study

The Murray-Darling Basin occupies one seventh of the Australian continent (1.06 million km^2; Fig. 1). Policy makers face problems typical of many large river basins globally: over-extraction of water for irrigation, declining health of flow-dependent ecosystems (Davies et al., 2010) and climate change impacts that are expected to reduce inflows (Vörösmarty et al., 2010). Additionally, balancing the interests of multiple uses of limited water resources – conservation significance, recreational, cultural, including Aboriginal culture, irrigated agriculture, urban

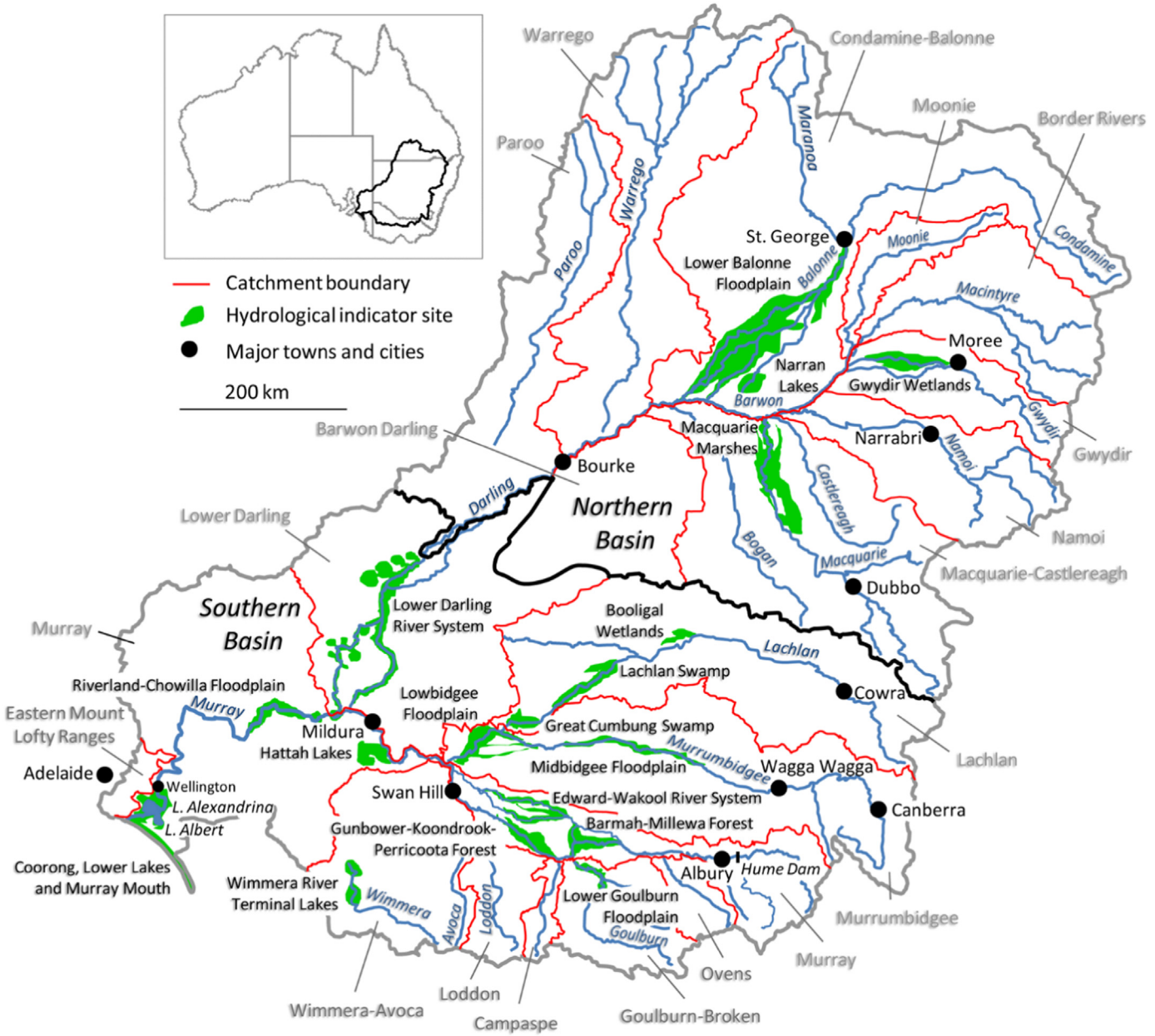

Fig. 1. The Murray-Darling Basin showing the major catchments, rivers and key hydrological indicator sites, subject to ecological targets under the Basin Plan (MDBA, 2012a). Inset: location map within Australia.