

The Sustainable Rivers Audit: assessing river ecosystem health in the Murray–Darling Basin, Australia

P. E. Davies^A, J. H. Harris^{B,E}, T. J. Hillman^C and K. F. Walker^D

^AFreshwater Systems, 82 Waimea Avenue, Sandy Bay, Tas. 7005, Australia.

^BHarris Research, 568 Bootawa Road, Tinonee, NSW 2430, Australia.

^C567 Brown Place, Lavington, NSW 2640, Australia.

^DSchool of Earth & Environmental Sciences, The University of Adelaide, SA 5005, Australia. Present address: PO Box 331, Yankalilla, SA 5203, Australia.

^ECorresponding author. Email: rifflerun@gmail.com

Abstract. The Sustainable Rivers Audit (SRA) is a systematic assessment of the health of river ecosystems in the Murray–Darling Basin (MDB), Australia. It has similarities to the United States' Environmental Monitoring and Assessment Program, the European Water Framework Directive and the South African River Health Program, but is designed expressly to represent functional and structural links between ecosystem components, biophysical condition and human interventions in the MDB. Environmental metrics derived from field samples and/or modelling are combined as indicators of condition in five themes (Hydrology, Fish, Macroinvertebrates, Vegetation and Physical Form). Condition indicator ratings are combined using expert-system rules to indicate ecosystem health, underpinned by conceptual models. Reference condition, an estimate of condition had there been no significant human intervention in the landscape, provides a benchmark for comparisons. To illustrate, a synopsis is included of health assessments in 2004–2007. This first audit completed assessments of condition and ecosystem health at the valley scale and in altitudinal zones, and future reports will include trend assessments. SRA river-health assessments are expected to play a key role in future water and catchment management through integration in a *Basin Plan* being developed by the Murray–Darling Basin Authority for implementation after 2011. For example, there could be links to facilitate monitoring against environmental targets.

Additional keywords: environmental monitoring, fish, floodplain, fluvial geomorphology, hydrology, macroinvertebrate, physical form, vegetation.

Introduction

Despite global evidence of widespread catchment degradation (e.g. Meybeck 2003), there are few large-scale programs of condition assessment to promote coordinated management of land and water resources within river basins and guide efforts to offset the historical legacy of fragmentation. Prominent examples include the Environmental and Monitoring Assessment Program (EMAP) of the US Environment Protection Agency (Stevens 1994) (<http://www.epa.gov/emap>), the European Union's Water Framework Directive (WFD) (Heiskanen *et al.* 2004; Hatton-Ellis 2008) (<http://c.europa.eu/Public/irc/env/wfd/library>) and the South African River Health Program (RHP) (CSIR 2007) (<http://www.csiro.co.za/rhp>). These programs may be complementary in matters of design and analysis. For example, information on indicator criteria and design from the EMAP program was useful in developing parts of the Sustainable Rivers Audit (SRA).

'Ecosystem health' cannot be measured directly. Instead, surrogate measurements and other observations are employed to indicate the system's capacity to support key processes (e.g. carbon exchange, nutrient cycling, energy transfer,

sediment transport, recruitment of biota), structural components (e.g. communities, populations) and resilience, and these data are integrated as a holistic assessment. The term implies a human value judgement and lacks a universal definition (e.g. Hearnshaw *et al.* 2005), but refers generally to the status of an ecosystem and its components in terms of structure, integrity, vitality and function, often relative to a benchmark. A river ecosystem is deemed 'healthy' when its essential character is maintained over time, allowing for sustainable levels of exploitation or other disturbances induced by human activities. 'Essential character' here refers to a suite of features including hydrological connectivity, sediment transport, biodiversity, nutrient and carbon cycling, recruitment, stability and resilience.

The SRA is a continuing, systematic assessment of the health of river ecosystems across the Murray–Darling Basin (MDB). The concept was developed in 2000 by the Murray–Darling Basin Commission (MDBC) and its six partner governments, and is intended to provide ecological data to support major and rapidly evolving investments in river management. It is currently managed by the Murray–Darling Basin Authority