SEDIMENTATION OF A TERMINAL FLOODPLAIN:

THE NARRAN SYSTEM

By

Robert Andrew Cossart
Ba. of Applied Science

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Riverine Landscapes Research Laboratory
Faculty of Science

University of Canberra, Bruce, ACT 2601, Australia

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This thesis acknowledges the traditional custodians of this land who have cared for and nurtured the landscape for tens of thousands of years

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Abstract

Environmental change is placing increasing pressure on the sustainability of many ecosystems. Floodplains are an ideal system for the investigation of long-term change within riverine landscapes, as they are sensitive to both natural and anthropogenic processes. Sediments contained within floodplain deposits represent an archive of historical change. Our knowledge of sedimentation within terminal dryland floodplains is limited and this impedes our ability to understand and manage them in the face of changing environmental conditions. The research presented in this thesis addresses an important knowledge gap in the area of terminal floodplain systems and it seeks to investigate the environmental history of a significant Australian terminal floodplain, the Narran system. The Narran system is a Ramsar wetland of international importance, located within the Lower Balonne Floodplain which straddles the NSW/QLD border. The Condamine Balonne catchment is a region of increasing land and water development which poses a threat to the functioning of this floodplain. .

This thesis employs a hierarchical study design to investigate the morphostratigraphic response of a terminal floodplain system to environmental change at a number of different scales. The results of this thesis demonstrate that the Narran system does not support the current conceptual models of sedimentation within terminal dryland floodplains. These models suggest terminal floodplains form as a result of mobile aggrading splays. This study demonstrates the Narran system to be a stable geomorphic feature that has formed as a series of terminal lakes and floodplains. A series of structural lineaments have confined the lakes to a small regional trough for at least 440 ka, while low sediment yields (3.9 to 13.9 kg km^2 yr^{-1}) have assisted in maintaining the stability of this system.

The Narran system is demonstrated to have a complex morphostratigraphic response to changing environmental conditions. The lakes have undergone a morphological divergence from one large basin approximately 440 ka ago, to two smaller basins about 330 ka ago, and more recently formed into three lakes around 78 ka ago. Overall the stratigraphy of the lakes and adjacent floodplain has displayed a reduction in fluvial energies, with sediment deposition changing from a system dominated by bed-load transport to one dominated by pelagic deposition. However, there have been three distinct periods of sediment accumulation. Up to 440 ka ago, sediments accumulating in the Narran system were indicative of a high energy

fluvial bed-load system that supplied well sorted sands derived from the upstream Condamine and Maranoa sub-catchments. This was followed by a period of fluctuating energy and sediment supply conditions and a fluctuating transition from a high-energy bed-load environment to a low-energy pelagic environment. The provenance of sediment that accumulated in the Narran system between 440 and 78 ka ago was highly variable, fluctuating between the Condamine and Maranoa sub-catchments. For the last 78 ka, the lakes have received sediment derived from the Maranoa sub-catchment whilst the floodplain has received sediment from both sub-catchments. It is suggested that the changing climatic and catchment influences on the Narran system are associated with glacial and inter-glacial oscillations and the growing aridity of eastern Australia.

A multi-proxy approach within a hierarchal framework was applied in this thesis to establish multiple lines of evidence of floodplain sedimentation. This approach has allowed patterns of sedimentation and processes influencing these to emerge at different levels of organisation. Each line of evidence established for the Narran system displayed a different pattern demonstrating that different patterns occur at different places in space and time. This has not previously been identified within terminal floodplains. The approach taken in this thesis is not a traditional method for investigating floodplain sedimentation. However, it highlights the utility of combining standard sedimentological techniques and multivariate statistics within a hierarchical framework to convey a high resolution of floodplain sedimentation. This thesis contributes to the science of floodplain sedimentation by providing a different perspective on the accumulation of sediments within a terminal dryland floodplain.

Table of Contents

List of Figures

Chapter 2: Literature Review

Chapter 3: Study Area, Design and Methods

Chapter 4: Sedimentation within Narran

Chapter 5: Catchment influences on Narran

Chapter 6: Synthesis

List of Tables

Chapter 1: Introduction

Chapter 3: Study Area, Design and Methods

Chapter 4: Sedimentation within Narran

Chapter 5: Catchment influences on Narran

Scientific publications and presentations arising from this thesis

Publications:

Cossart R.A, Thoms M.C. & Reid M. A. (2008). *Determination and interpretation of sediment provenance in a sedimentary sequence affected by post-depositional changes*. Sediment Dynamics in Changing Environments (Proceedings of a symposium held in Christchurch, NZ, December 2008). International Association of Hydrological Sciences Publications, **325**: 60-69.

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