Are the Northland rivers of New Zealand in synchrony with global Holocene climate change?

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in Geography

at Massey University, Palmerston North, New Zealand

MASSEY UNIVERSITY

Jane Richardson

2013

Abstract

Climate during the Holocene has not been stable, and with predictions of human induced climate change it has become increasingly important to understand the underlying 'natural' dynamics of the global climate system. Fluvial systems are sensitive respondents to and recorders of environmental change (including climate).

This research integrates meta-data analysis of a New Zealand fluvial radiocarbon (^{14}C) database with targeted research in catchments across the Northland region to determine the influence of Holocene climate change on river behaviour in New Zealand, and to assess whether or not Northland rivers are in synchrony with global climate change. The research incorporates ^{14}C dating and meta-analysis techniques, sedimentology, geophysics, ground survey (RTK-dGPS) and Geographic Information Systems analysis to investigate the response of New Zealand and Northland rivers to Holocene climate and anthropogenic change.

The emerging pattern of Holocene river behaviour in New Zealand is one of increased river activity in southern regions (South Island) in response to enhanced westerly atmospheric circulation (promoted by negative Southern Annular Mode [SAM]-like circulation), while in northern regions (North Island) river activity is enhanced by meridional atmospheric circulation (promoted by La Niña-like and positive SAM-like circulation). In Northland, Holocene floodplain development reflects the interplay between valley configuration and accommodation space, sediment supply, fluctuation in climate and anthropogenic factors in the last several hundred years. Evidence from Northland rivers suggests that a globally extensive abrupt climate change signal can promote a synchronous fluvial response, overprinting complex regional patterns of Holocene river behaviour.

The research demonstrates that at the centennial-scale, regional atmospheric circulation change is a key driver of river behaviour, with anthropogenic catchment disturbance responsible for enhanced river activity and floodplain aggradation in the last ~ 500 years. It is therefore likely that any future climate change involving a shift in the atmospheric

circulation regime will have an impact on river behaviour in New Zealand. However, at the catchment- or reach-scale, river response will be largely determined by local controls such as sediment supply and accommodation space, with these factors largely moderated by the post-settlement fluvial history.

Acknowledgements

I would like to express my appreciation to my supervisors, Dr Ian Fuller (Massey University), Dr Kat Holt (Massey University), Dr Nicola Litchfield (GNS Science) and Professor Mark Macklin (Aberystwyth University) for their support and guidance during this PhD research. I am also particularly grateful for the technical support provided by David Feek (Massey University) during the fieldwork phase of this project.

I wish to thank the following organisations for their financial support over the last three years: the Tertiary Education Commission (Top Achiever Doctoral Scholarship), New Zealand Federation of Graduate Women (Susan Byrne Memorial Award), Zonta Manawatu (Women in Science and Technology Scholarship sponsored by Graduate Women Manawatu), Massey University School of People, Environment and Planning (Graduate Research Fund) and Massey University Institute of Agriculture and Environment.

Several people have contributed their time and expertise, and I would like to acknowledge their contribution: Dr Henry Lamb (Aberystwyth University) for undertaking the XRF core scanning, Michael Hayes for supplying information on the settlement of Kaeo, Dr Bob Stewart (Massey University) and Professor Vince Neall (Massey University) for advice on sedimentology, Dr Mark Bebbington (Massey University) for assistance with statistical analysis, Dr Anja Moebis (Massey University) for help with grain size analysis and Hamish Mckoy (formerly Victoria University of Wellington) for training in the use of the percussion coring equipment. LiDAR data was kindly supplied by the Northland Regional Council (Bob Cathcart, Joseph Camuso, Jonathan Santos and Colin Anderson). I would also like to thank the landowners for permitting access to the Northland study sites.

Special thanks also to my fellow students for their contributions and support, especially Rob Dykes and Dr Alastair Clement for their technical advice. Finally, I would like to thank my family and friends. Thank you to Glen, Georgia, Sophie, Jack and Isabel for all their tolerance, love and support, and to Monica and Dennis who instilled in me the desire for knowledge.

Thesis structure and authorship

This thesis consists of four manuscripts written for publication in appropriate journals (currently still under review) and six supporting chapters.

Jane Richardson carried out all the fieldwork in Northland between November 2009 and October 2011, and was assisted at different times by Dr Ian Fuller, Dr Katherine Holt, Dr Nicola Litchfield and David Feek. Jane Richardson also undertook all laboratory work included in this thesis with the assistance of Dr Henry Lamb (Aberystwyth University), Dr Anja Moebis (Massey University) and Dr Bob Stewart (Massey University).

Jane Richardson wrote all the text in this thesis and was the principal author in the preparation of manuscripts included in this thesis. Manuscripts are co-authored by others to acknowledge their input (see Appendix F for statements of contribution). Dr Ian Fuller and Prof. Mark Macklin developed the initial project, and all supervisors provided general advice and edited manuscripts. Dr Mark Bebbington performed the statistical analysis in Chapter 4. Dr Anna Jones advised on the analysis of the New Zealand fluvial radiocarbon database and contributed to the final editing of the manuscript presented in Chapter 4. Use of the New Zealand fluvial radiocarbon database is referenced as Macklin et al. (2012a).

Signed by Principal Supervisor:

Dr Ian Fuller

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