Completed Projects
1999-2002

River Restoration

Project 6.3: Restoration Ecology in the Granite Creeks, Victoria

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Introduction

Past research has provided general models of channel recovery from disturbance. This joint project with the CRC for Freshwater Ecology (CRCFE) was designed to push the science further, by quantifying the physical and ecological response to intervention. We chose to work on sand-slugs as these are a reasonably simple 'pulse' disturbance. We placed 40 log structures and control sites into the Creighton and Castle Creek systems and measured scour around these logs and controls, as well as developing an instrument for measuring continuous scour.

Research outcomes

General sand-slug recovery models

The Granite Creek project (in Victoria) is embedded within a general model of sand-slug recovery. For her PhD, Rebecca Bartley investigated whether the classical 'wave' model of recovery following a sand slug always applies. This model suggests that the return of the pre-slug bed-elevation is associated with an automatic recovery of 'geomorphic complexity'. The model does not apply in the Granite Creeks. In fact, there can be sudden increases and decreases of complexity as the sand slug move through the stream. Such recovery models are critical for advancing stream rehabilitation. Figure 1 provides an example of the many measures made.

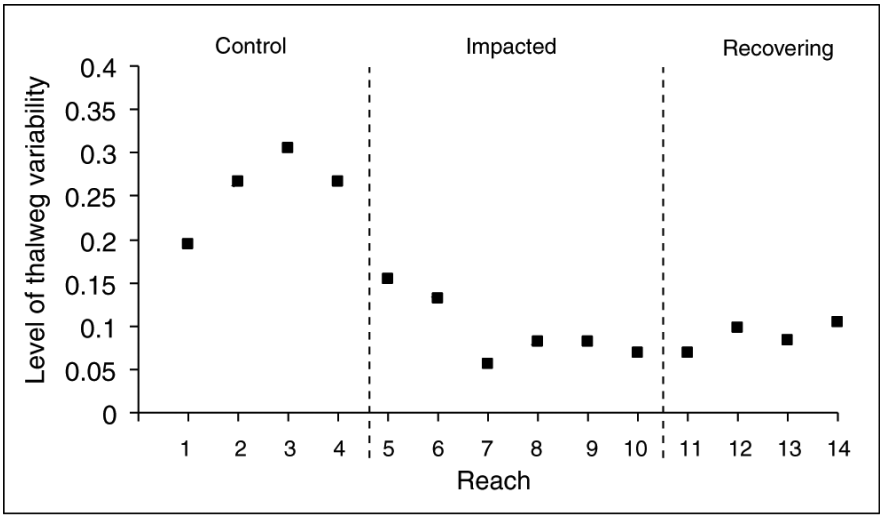

Figure 1: Thalweg variability measured along Creightons Creek using the Standard Deviation method

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Log Experiments: Advances in Methods

The original plan for this project was to test the maximum scour model developed by Dr Nick Marsh. However, this model requires at least bankfull discharges. Since there were no such discharges during the three year period of the project, we instead developed a much more useful stochastic scour model. This approach is only possible with continuous monitoring of scour depth and we developed a method to measure this.

The project assessed the scour around uniform logs placed in the bed. Although there have been other similar projects completed, we developed a novel bed-level monitoring method that allowed us to measure the change in bed-level continuously, not just before and after a hydrograph has passed, as with other methods. Already this pressure transducer based device is being deployed in the much larger Snowy River rehabilitation project.

Results of log scour study

Nick Marsh's PhD on scour around logs used scour theory from underwater pipes to provide a method that estimated maximum scour depth. This method works well at flows close to bankfull, but unfortunately the experiment described here took place in a five year drought. In any case, it quickly became clear that such engineering 'failure' approaches are little use in dealing with biological processes. We have now developed a 'stochastic scour' approach that examines the 'probability that a series of flows will occur that will provide biologically important scour (as opposed to simply large scour). For example, what is the probability that deep winter scour will not be filled-in by moderate flows before the spring spawning period? This stochastic approach is a profoundly more useful approach to ecology and engineering structures. We also completed five routine measures of all 40 log structures.

The science component of the project received a detailed review from an international panel (December 2002) as part of the CRCFE review process. A full report of this review is available on request. Whilst the panel was enthusiastic about the quality and progress of the science in this project, they did observe that the physical and biological elements of the project need to be more closely meshed. We are currently progressing this by developing joint conceptual models.

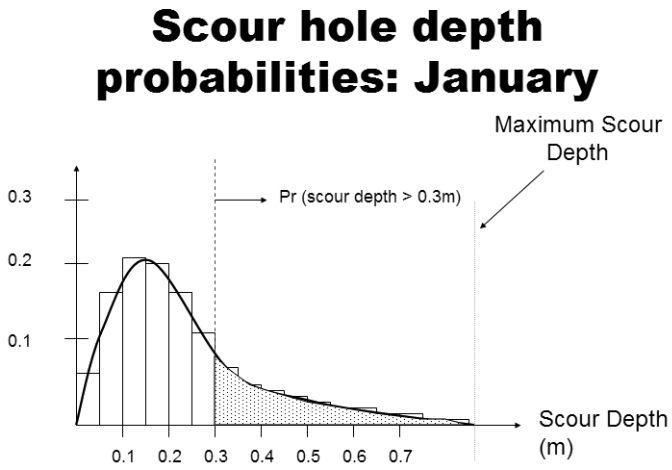

Figure 2: Example of a scour probability function for January for Creightons Creek (critical period for shelter for fish)

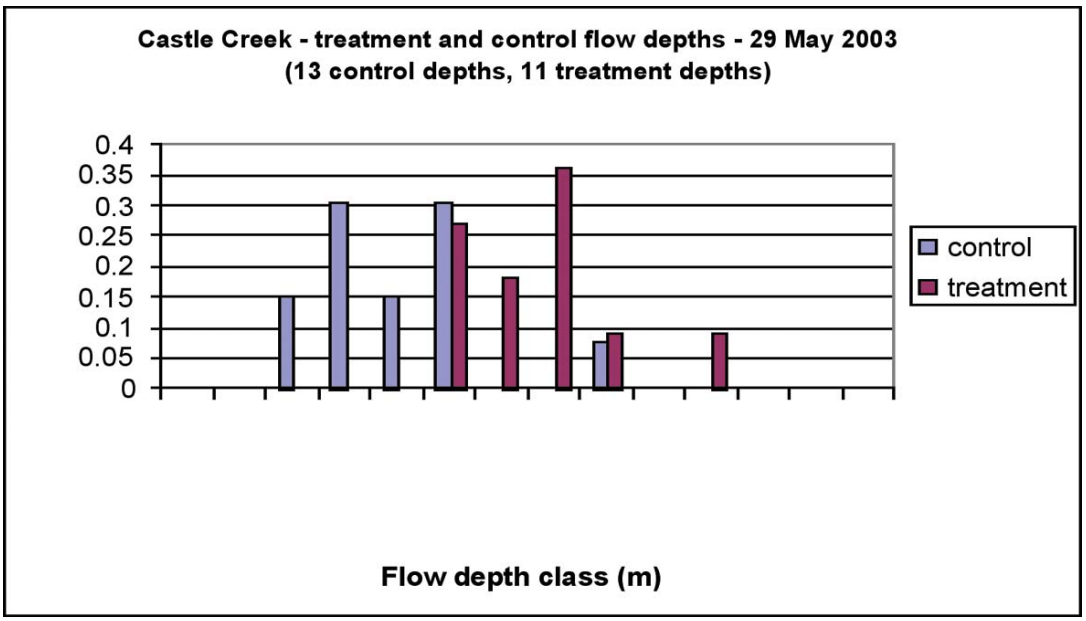

Figure 3: Scour depths (i.e. flow depths) below artificial logs in Castle Creek (this shows that scour depth below the logs is greater than corresponding depths for control sites).

Application of the research outcomes

This is a long-term project that is intended to establish scientific goals – it is not advocating placing wood in streams as a simple method of 'rehabilitation'. However, we can report with confidence that providing even modest variability in the bed leads to a measurable increase in fish numbers and diversity.

We can also report that the past 'wave' model of recovery following a sand slug does not always apply. That is, the return of the pre-slug bed-elevation is seldom associated with an automatic recovery of 'geomorphic complexity'. In fact, there can be sudden increases and decreases of complexity as the sand slug move through the stream. Such recovery models are critical for advancing stream rehabilitation.

For further Information

Bartley, R. and D. I. Rutherfurd, (Submitted) Re-evaluation of the wave model as a tool for quantifying the geomorphic recovery potential of streams disturbed by sediment slugs. Geomorphology.

Bartley, R. and I. D. Rutherfurd (In Press), Measuring the reach-scale physical diversity of streams: review of methods and an application to sandslug streams. Rivers Research and Application.

Bartley, R. and I. Rutherfurd (2002). Techniques to quantify the variability of thalweg profiles. The Structure, Function and Management Implications of Fluvial Sedimentary Systems. Alice Springs, Australia, IAHS Publ. no. 276: 35-44.

Bartley, R., (2001). Predicting pre-disturbance pool depth: a tool for stream rehabilitation. Proceedings of the 29th International Congress of the Association of Hydraulic Research, Beijing.

Bartley, R. and I. Rutherfurd, (2001) Quantifying the geomorphic recovery of streams disturbed by anthropogenically produced sediment slugs. Proceedings of the 5th International Conference on Geomorphology, Tokyo.

Bartley, R., I. Rutherfurd, J. Davis and B. Finlayson, (2001) Creightons Creek (a case study of sediment delivery and recovery). Nagano, Japan., Matsmoto Sabo Work Office, Ministry of Land, Infrastructure and Transport, Japan: 140-147.

Bartley, R., I. Rutherfurd, P. Hairsine, I. Prosser, P. Wallbrink and D. Perry, (2001) Australia is on the move…down the creek: A brief insight into the impacts of increased sediment delivery for Australia's streams and rivers. Australian Landcare Magazine December.

Bartley, R. and I. Rutherfurd (2001). Quantifying the geomorphic recovery of streams disturbed by anthropogenically produced sediment slugs. Proceedings of the 5th International Conference on Geomorphology. Tokyo.

Bartley, R., I. Rutherfurd, et al. (2001). Australia is on the move…down the creek: A brief insight into the impacts of increased sediment delivery for Australia's streams and rivers. Australian Landcare Magazine. December.

Marsh, N., I. Rutherfurd, et al. (2001). Predicting Pre-disturbance Loading and Distribution of Large Woody Debris. Third Australian Stream Management Conference. Brisbane, Australia, CRCCH.

Marsh, N., I. D. Rutherfurd, et al. (1999). Large woody debris in some Australian streams: natural loadings, distribution and morphological effects. Second Australian Stream Management Conference. I. D. Rutherfurd and R. Bartley. Adelaide, South Australia, Cooperative Research Centre for Catchment Hydrology: 427-432.

Rutherfurd, I., F. Sheldon, et al. (2001). The Value of healthy rivers. Third Australian Stream Management Conference. Brisbane, Cooperative Research Centre for Catchment Hydrology.

Rutherfurd, I. D. (2001). Some human impacts on Australian stream channel morphology. River management: The Australasian Experience. S. O. Brizga and B. Finlayson, Wiley.

Rutherfurd, I. D. (2001). Storage and movement of slugs of sand in a large catchment: developing a plan to rehabilitate the Glenelg River, SE Australia. Applying geomorphology to Environmental Management. D. J. Anthony, Harvey, M.D., Laronne, J.B., and Mosley, M.P. Denver, Water Resources Publications: 309 - 332.

Rutherfurd, I. D. and C. Gippel (2001). Australia versus the World: do we face special opportunities and challenges in restoring Australian streams? Water Science and Technology. 43: 165-174.

Wilkinson, S., R. Keller, and Rutherfurd, I.D. (2001). Aspects of the Rehabilitation of Pool-Riffle Sequence Bedforms. The Value of healthy rivers: Third Australian Stream Management Conference. I. Rutherfurd, F. Sheldon, G. Brierley and C. Kenyon. Brisbane, Cooperative Research Centre for Catchment Hydrology.

Wilkinson, S., R. Keller, and Rutherfurd, I. (2001). Environmental Flow Thresholds for Maintenance of Pool-Riffle Sequences. Conference on Hydraulics in Civil Engineering. Hobart 28 -30 November 2001, The Institution of Engineers, Australia. 1: 513-522.

Wilkinson, S. and I. Rutherfurd (2001). Flushing flow recommendations for the Yarra River below Upper Yarra Dam. Melbourne, Department of Natural Resources and Environment, Victoria.

Wilkinson, S. and I. Rutherfurd (2001). Potential impact of Basslink on the time averaged sediment transport rate in the Gordon river. Melbourne, University of Melbourne.

Rutherfurd, I. and R. Bartley (2000). Physio-therapy for your stream: the dangers and potential of geomorphic models of stream disturbance and recovery in stream rehabilitation. Murrumbidgee 2000 Conference. Charles Sturt University, Wagga Wagga.

Rutherfurd, I. and K. Jerie (2000). Resurrecting the dead: can fluvial geomorphology work miracles in rehabilitating australian streams? 5th Australia New Zealand Geomorphology Group Conference. B. Bourman. Goolwa, SA.

Rutherfurd, I. D. and K. Jerie (2000). Setting priorities for rehabilitating streams: first identify the assets! International Landcare Conference. Melbourne, Landcare Australia.