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River Restoration

Project 6.4: Evaluation of the effectiveness of riparian management in SE Queensland

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Introduction

Despite the considerable government and private resources invested in the rehabilitation of damaged environments, little is known about the success of such projects. This CRC for Catchment Hydrology project was been developed in collaboration with the CRC for Freshwater Ecology (CRCFE) and the Moreton Bay and Catchments Healthy Waterways Partnership.

Project objective

The project aimed to quantify the affect of a commonly adopted stream rehabilitation methodology on a small stream.

The rehabilitation strategy used was to exclude stock by fencing off the riparian zone, provide off-stream watering and revegetate the riparian zone using native species. The key research issues investigated were:

- The response of channel morphology to riparian restoration;
- Effect of riparian restoration on suspended sediment delivery and load;
- Effect of riparian restoration on in-stream temperature; and
- The response of aquatic macrophytes to habitat change.

The basic experimental design was a BACI (before, after, control, impact) style design with the target stream (Echidna Creek, Queensland) and two control streams continuously monitored for two years.

The basic methodology for the four key research issues was:

1. The response of channel morphology to riparian restoration;

- Detailed channel survey (0.3m resolution) before restoration
- Installation of permanent survey marks for assessing channel change
- Photo points

2. Effect of riparian restoration on suspended sediment delivery and load;

- Continuous turbidity logging at treatment and control streams
- Establishing a turbidity-suspended solids relationship for the catchment
- Converting turbidity measurements to an equivalent suspended solids concentration

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- Establishing gauging stations of each stream
- Calculating total suspended solids load from each stream using instantaneous discharge and suspended solids data
- Comparing the treatment and control streams through time to detect a change in relative suspended solids load following revegetation

3. Effect of riparian restoration on in-stream temperature;

- Continuous logging of water temperature in treatment and control streams
- Short term logging of water temperature in other streams to determine the regional applicability of the findings
- Comparison of water temperature records during the establishment of vegetation.

4. The response of aquatic macrophytes to habitat change.

- Establishment of 50 permanent transects (each with 1-3 permanent quadrats) on the treatment stream
- 6-12 weekly monitoring of macrophyte growth in transects and quadrats
- Comparison of macrophyte growth with the hydrologic, climate and canopy cover record to establish models relating macrophyte distribution to environmental variables.

Research outcomes

The final report for this project is still to be completed. The outcomes for this project can be considered in terms of methodological outcomes, scientific advances and management impacts.

1) Methodological outcomes

a) The response of channel morphology to riparian restoration:

Using photo points to illustrate channel change can be very informative, however when coupled with a revegetation project it is difficult to establish photo points that will not be obscured by plant growth. Low level photography has proven useful in overcoming this problem.

The response of channel morphology is highly spatially and temporally variable and fixed survey points are a poor way of detecting change unless a very large number are installed. Detailed channel surveying and creation of digital terrain models of the channel are a more effective way of determining channel change.

b) Effect of riparian restoration on suspended sediment delivery and load:

- We demonstrated that continuous monitoring of suspended sediment (via turbidity) can be a cost effective and accurate method of quantifying sediment transport from a stream system.
- Methods of turbidity logger installation and maintenance have been perfected to limit day to day maintenance concerns.

c) Effect of riparian restoration on in-stream temperature:

The installation and maintenance of water temperature loggers is a reliable, inexpensive and informative way to investigate cover-temperature interactions.

d) The response of aquatic macrophytes to habitat change:

The iterative development of an effective sampling regime will be informative to future aquatic macrophyte research projects.

2) Scientific advances

a) The response of channel morphology to riparian restoration

The detailed topographic survey of the treatment stream (approx 3km) before and after revegetation showed the source of sediment movement over the treatment period. In addition the continuous suspended sediment monitoring and discharge monitoring provided a measure of the total load of sediment discharged from the catchment. The result was a detailed quantification of the event based load of sediment delivered from in-channel and out-of-channel sources. This detail can be used to validate the SedNet model.

b) Effect of riparian restoration on suspended sediment delivery and load:

The event by event quantification of suspended sediment losses from Echnidna Creek allowed us to quantify the role of riparian vegetation in net sediment loss from the catchment.

c) Effect of riparian restoration on in-stream temperature:

- The continuous temperature monitoring throughout the treatment and control streams allowed us to validate a water temperature model (see report Rutherford, J. (2003) Stream temperature prediction in South-East Queensland, NIWA report AUS2002-012).
- Continuous temperature monitoring allowed us to quantify the role of riparian vegetation in stream temperature control by observing changes in stream temperature as vegetation has regrown.

d) The response of aquatic macrophytes to habitat change:

Highly significant models of macrophyte presence/absence were developed using the data for Echidna creek. Key predictors in the models are canopy cover, water depth and hydraulic habitat. The ability to predict the distribution of key macrophyte species from physical attributes is useful for future stream rehabilitation projects.

3) Management impacts

- The continuous monitoring of both temperature and suspended solids provided a planning timeframe for stream rehabilitation works. Initially both suspended sediment loads and temperature increased due to the removal of weedy vegetation, however after two years of vegetation growth these levels dropped to pre-rehabilitation levels, and continued to fall.
- The whole of catchment revegetation project provided a great demonstration site for illustrating the importance of large scale treatments.

Application of research outcomes

The main research integration outcome is the potential application of Echnina Creek sediment load data (quantified as 'within channel' and 'floodplain plus slopes') to the validation of the in-channel erosion component of SedNet. For further information about SedNet see www.toolkit.net.au/sednet

This localised calibration of SedNet will permit more confident application of the model by the Queensland Department of Natural Resources, Mines and Energy.

The Echidna creek rehabilitation project is used as a model by the south-east Queensland Water Quality Monitoring Strategy group for the success of large-scale stream rehabilitation projects.

For further information

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