CAREX: Improving restoration tools for small lowland agricultural streams

Jon S Harding, Catherine M Febria, Nicky Glenjarman, Katie Collins, Kristy Hogsden, Angus R McIntosh

School of Biological Sciences, University of Canterbury, Christchurch New Zealand

CAREX and the problem

The Canterbury Waterway Rehabilitation Experiment (CAREX): a 10 year research programme aiming to improve the effectiveness of riparian management tools in headwater agricultural waterways.

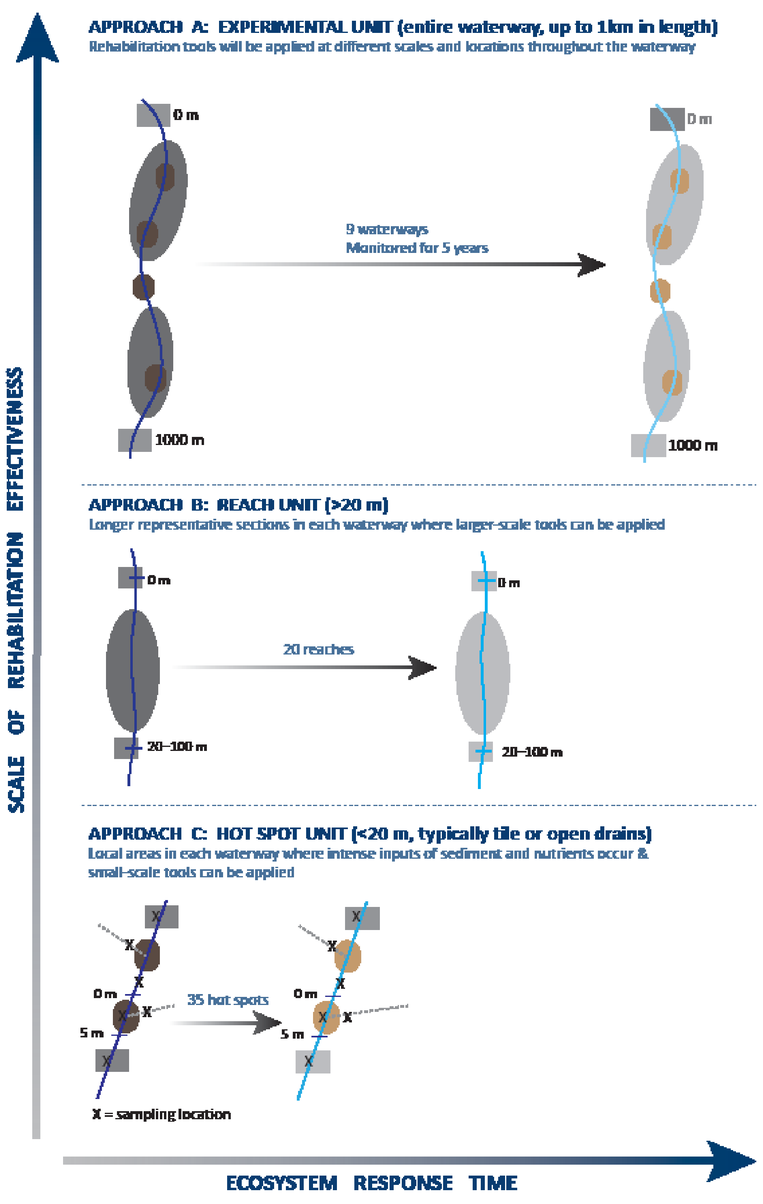
Many small (1st–2nd order) lowland agricultural streams are subjected to pressures which degrade water quality.

On the Canterbury Plains, New Zealand, these are:

- excessive nutrients (e.g., nitrate >6 mg/L),
- fine sediment (>20% bed cover) and
- nuisance macrophyte growth (summer >50% cover)

Restoration frequently focuses on riparian planting and fencing out livestock assuming that water quality and stream health will improve. Unfortunately many projects fall short of improving in-stream conditions often due to applying general tools for specific problems.

We are investigating how to better apply management and restoration tools at different scales in nine 1-km long headwater waterways representing independent gradients of in-stream nitrate and sediment impairment. All waterways are also impacted by nuisance macrophytes.



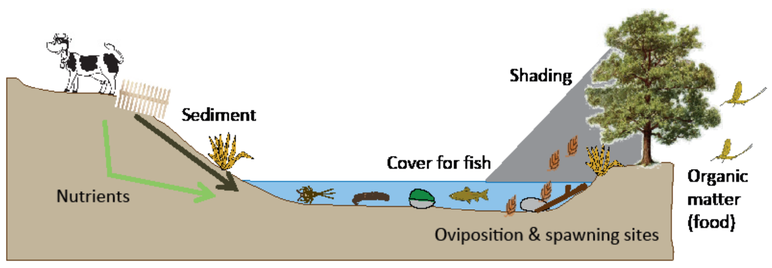
Trials include macrophyte control experiments, constructing sediment traps, and addition of in-stream habitat.

CAREX Canterbury Waterway Rehabilitation Experiment

A project funded by the Mackenzie Charitable Foundation

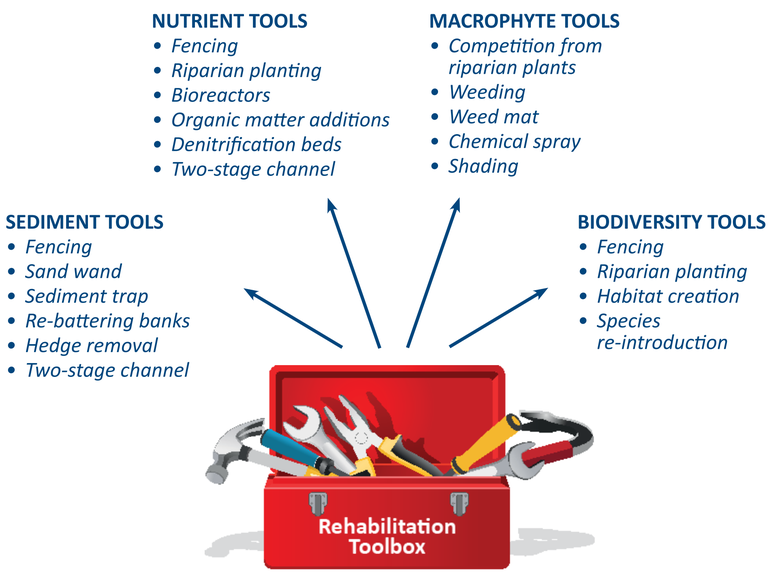
Riparian management to achieve all functions

Many stream restoration projects use "generic" planting guides which incorporate native vegetation and are aesthetically pleasing, but do not necessarily provide the full functions needed to improve stream health.



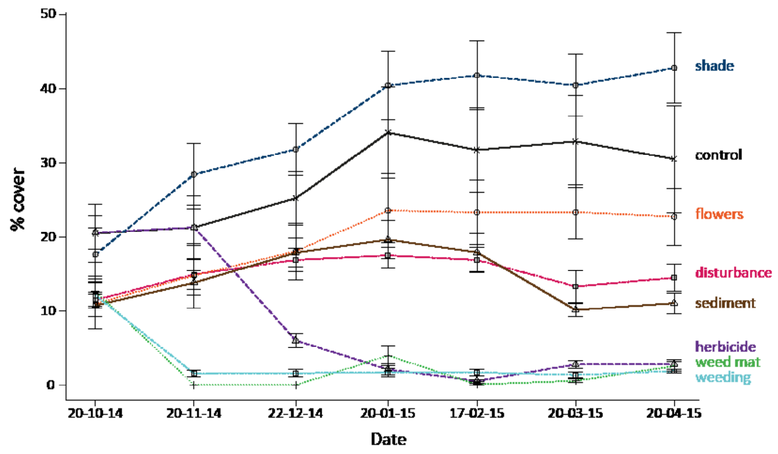
Developing an effective toolbox

We are trialling multiple tools that can be used alone or in combination to address sediment, nutrient, macrophyte and biodiversity issues.



Reducing macrophyte cover

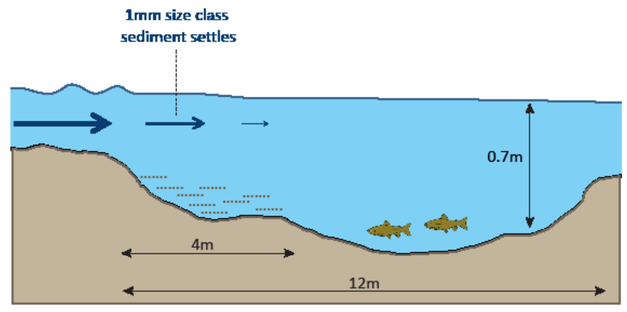
Nuisance macrophytes can fill waterways, raise water levels, and accumulate sediment. In a 250m stream reach, we have 56 plots (2 x 2m) in which we are trialling 8 treatments to control macrophyte growth and spread;



Trials show herbicide, weed mat and hand weeding are very effective at reducing macrophyte cover. Plant and bed sediment disturbance does reduce plant growth, while partial shading enhances macrophytes by providing protection from sun & wind.

Reducing fine sediment control

Excessive fine sediment can clog stream beds, enable macrophyte growth, and reduce habitat for aquatic biota. We are trialling a number of tools to reduce sediment transport and sediment legacies. One tool is the use of sediment traps at the top of our reaches;

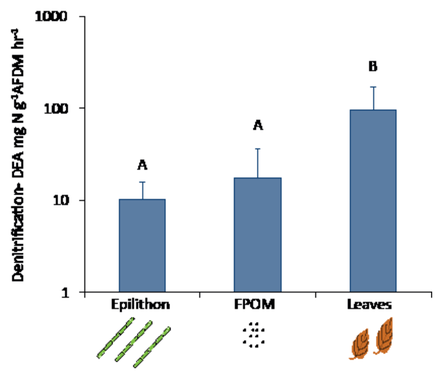


In this sediment trap approximately 70% of fine sediment passing along the reach is trapped.

Reducing in-stream nutrients

In Canterbury streams nitrate levels can reach as high as 15 mg/L. Nitrate enters the waterways from the groundwater, from sub-surface tile drains and to a lesser extent from surface run-off.

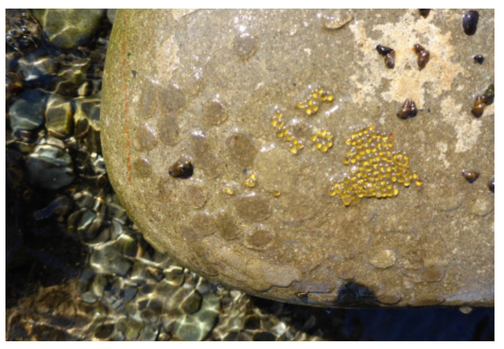
One strategy we are testing to reduce nitrate levels is to increase in-stream denitrification. In three streams, we added leaf packs increasing organic matter and thereby increasing microbial activity.



Adding leaf packs equivalent to the amount of leaves that might be generated by 40% forest cover increased in-stream denitrification by orders of magnitude compared to the denitrification rates from algae on cobble substrate.

Improve in-stream habitat

Important habitat features for freshwater biota are often missing from agricultural waterways. We have added boulders and wood to seven riffles in a 250m reach of a waterway to determine the value of habitat for invertebrates and fish.



Initial results show these habitats have been used as oviposition sites for invertebrates and habitat by small fish.

Acknowledgements

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Take home messages

The chances of agricultural stream restoration being successful will be improved by;

- **Starting restoration at the headwaters of the catchment**
- **Fixing "leaky" plumbing i.e. hot spots of sediment and nutrient inputs**
- **Planting the right riparian plants to fulfil a full range of functions**
- **Addressing in-stream legacies, such as excessive fine sediment & poor habitat**
- **Improving in-stream physical habitat**
- **Recognising that one restoration tool will rarely be sufficient, and that a tool box of multiple tools might be needed to improve water quality, habitat and overall waterway health.**

Poster design by Matt Walters