CAREX: Trialling sediment traps and the sand wand to remove excessive fine sediment in agricultural waterways

Jon S Harding, Nicky PC Glenjarman, Catherine M Febria, Kristy L Hogsden & Angus R McIntosh

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

CAREX and the problem

The Canterbury Waterway Rehabilitation Experiment (CAREX), is a 10 year research programme, which aims to improve the effectiveness of riparian management tools in headwater agricultural waterways leading to improved freshwater ecosystem health.

Many small (1st-2nd order) lowland agricultural streams are subjected to a number of pressures which degrade water quality and reduce aquatic diversity and impact stream communities.

On the Canterbury Plains, New Zealand, these are:

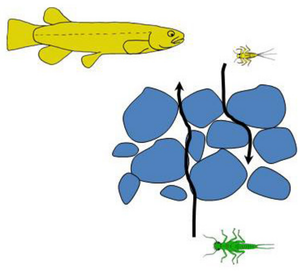
- elevated nutrients (e.g., nitrate >6 mg/L),
- excessive fine sediment (>20% bed cover) and
- nuisance macrophyte growth (summer >50% cover)

Excessive fine sediment (<2mm) is increasingly recognised as a significant contaminant in agricultural waterways. This sediment can clog stream beds, enable macrophyte growth, and reduce habitat for aquatic biota. As part of the CAREX programme, we have been trialling tools to reduce or remove excessive fine sediment from lowland agricultural waterways.

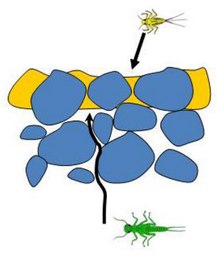
Sediment covers substrate in many agricultural waterways.

Why is excessive sediment a concern?

Natural stream bed



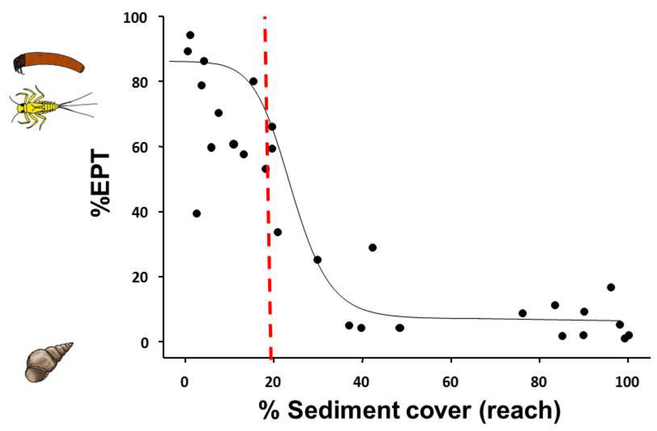
High deposited sediment



- interstitial spaces provide refuge from floods and predators
- invertebrates and other organisms live in the zone beneath the stream bed

Is there a sediment threshold?

Mayflies, stoneflies and caddisflies can be negatively impacted by deposited fine sediment bed cover exceeding approximately 20%, and that legacies of long-term sediment can prevent recovery even when sources are controlled.



Burdon et al. (2013)

Where does fine sediment come from?

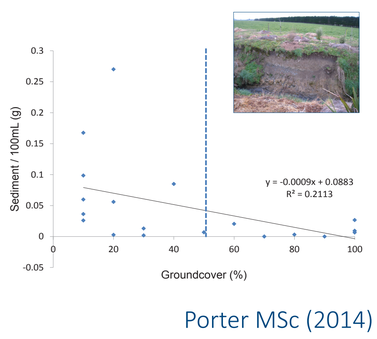
Fine sediment enters waterways from numerous sources including: livestock trampling riparian zones; overland run off from paddocks; bank erosion and slumping; wind blown, sub-surface and open tile drains; natural springs upwelling.

How can we reduce fine sediment in waterways?

- *Fencing*
- *Sand wand*
- *Sediment trap*
- *Re-battering banks*
- *Hedge removal*
- *Two-stage channel*

If sediment is coming from the riparian zone best practice includes:

- fencing to exclude livestock
- rebattering banks to reduce erosion and stop bank collapse
- maximising riparian vegetation cover e.g. >50% grass cover



Porter MSc (2014)

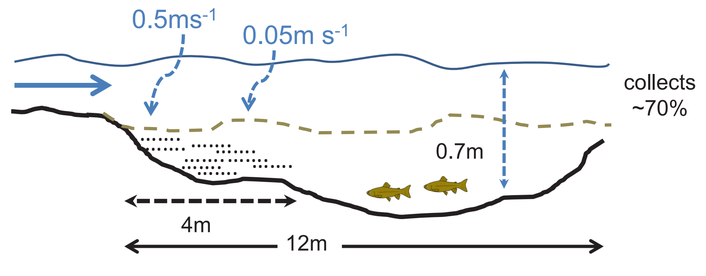
How can we reduce sediment legacies?

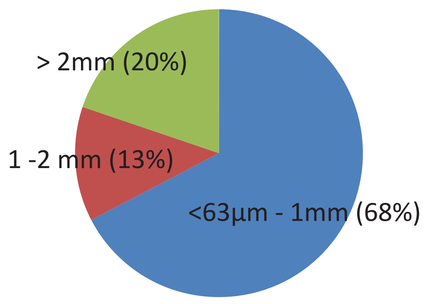
We are trialling two particular tools; sediment traps and use of a sand wand to vacuum sediment.

Sediment trap trial

A 12m long (0.7m deep) trap was dug in a 2.5m wide, low gradient farm waterway. Our sediment trap length is 4.8 times the wetted width of waterway, which falls within the range (4 - 10 times wetted width) suggested by Hudson (2002).

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





Most sediment collected in the trap was very fine.

The trap collected 60-70% of the fine sediment entering the reach over a 8-month period. The theoretical trap efficiency for this trap is about 95% for 125µm sediment based on Hudson (2002). .

Sand wand trial

A Sand Wand™ (Streamside Environmental) was used to remove sediment from two sediment traps and three 10m reaches of a small waterway (approx. 2.5m wide).

Sand wanding resulted in a reduction of fine sediment cover from approximately 40% cover to 10-20% cover. The sand wand was effective at removing loose sediment from depositional habitats (e.g., a pool or sediment trap) but doesn't work well in shallow water (<20 cm deep). The wand is labour intensive and the removed sediment needs to be deposited elsewhere.

Sediment removed from the waterway using the sand wand was dispersed on an adjacent paddock.

Waterway bed substrate revealed and a lamprey that came to check out potential new habitat after sand wand was used.

Take home messages

The chances of agricultural stream restoration being successful will be improved by reducing or removing sediment input and legacies;

- **First fence to exclude livestock**
- **Ensure maximum riparian plant ground cover (e.g. > 50%)**
- **Fix "leaky riparian plumbing" i.e. remove hot spots of sediment inputs such as bank slumping**
- **Recognise that one restoration tool will rarely be sufficient, and that a tool box of multiple tools might be needed to reduce sediment legacies**

Acknowledgements

We thank the Mackenzie Charitable Foundation for funding this research. The project would also not be possible without the support of landowners, Fish & Game New Zealand, Waimakariri District Council, Environment Canterbury and members of the CAREX team.

CAREX Canterbury Waterway Rehabilitation Experiment

A project funded by the Mackenzie Charitable Foundation

References

Burdon F., Harding J.S., McIntosh A.R. (2013). Habitat loss drives threshold response of benthic invertebrate communities to deposited sediment in agricultural streams. Ecological Applications 23(5): 1036-1047.

Hudson, H.R. (2002). In-channel coarse sediment trap Best Management Practice.Environmental Management Associates Ltd., Christchurch

Porter E.M. (2014). Riparian management: investigating public perception and the effect of land-use, groundcover and rainfall on sediment retention. Unpublished MSc thesis, University of Canterbury.

Streamside Environmental http://www.streamsideenvironmental.com/sand-wand_data/