

Stream recovery; Copper in waterways

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Photo courtesy of Timberlands Limited

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The flood – April 2011



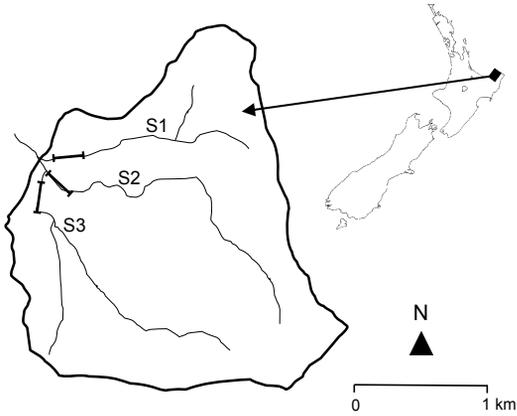
Photos courtesy of E. Kopu

- 1-in-100 year flood event (280mm in 24 hours)

- Effects in Houpoto Forest



A unique opportunity- to measure stream recovery



- Data from 3 streams in mature forest, with native riparian vegetation (before)
- Monitor recovery rate of an extreme flood event in recently harvested streams for 5 years (after) – “the event”
- Measured a range of riparian, stream habitat, aquatic invertebrate & native fish parameters



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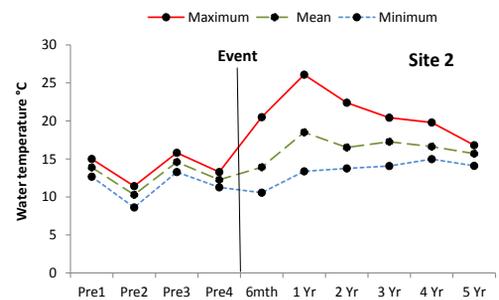
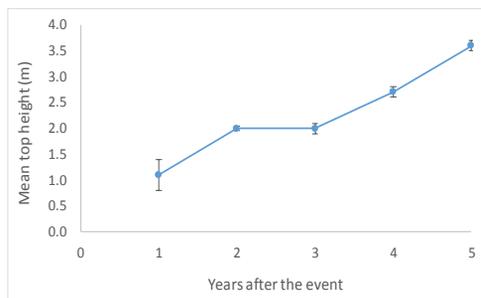
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Riparian & stream water temperature

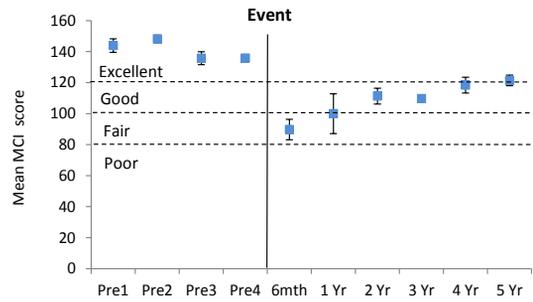
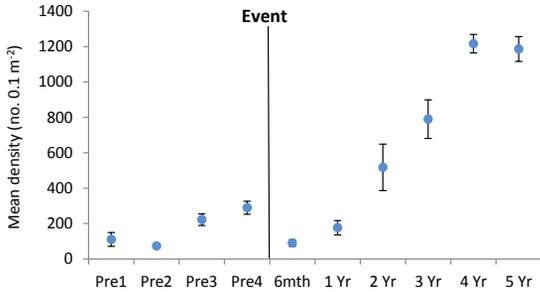


Pre-harvest 1 yr post harvest after event 3 yrs later 5 yrs later

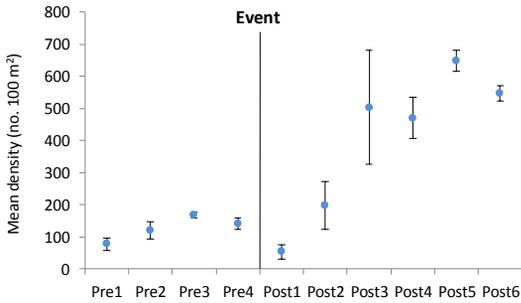
- Stream temperature recovery closely linked to riparian vegetation recovery



Aquatic invertebrate recovery



Native fish recovery

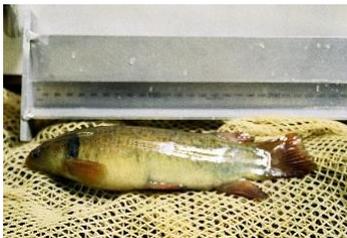


Post-event increase

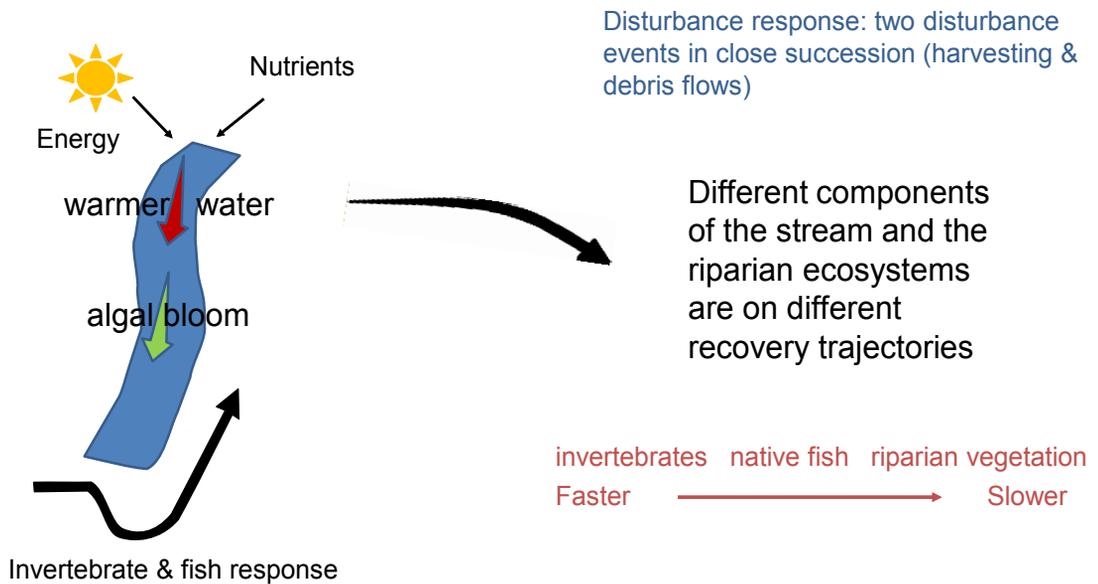
- redfin & bluegill bullies
- smaller longfin & shortfin eels
- inanga (pools only)

Post-event decline

- banded kokopu
- common bullies
- common smelt (autumn & pools only)



Stream recovery – what happened



Stream recovery - take home messages

- Debris flows: extreme physical events for a stream, particularly combined with harvesting
- Impact – social licence to operate
- Quantitative data: these small headwater streams are resilient and will recover over time (3-streams, one site)
- The rate of recovery of different species varies and changes with time; some species thrive, others yet to recover
- Riparian recovery key factor – interventions to manage recovery/mitigate impacts
 - Re-planting
 - Re-introduction of woody debris (but note NES that requires removal of all logging slash)
- Future re-measurements
 - 10 years or when key species return?



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Copper in waterways

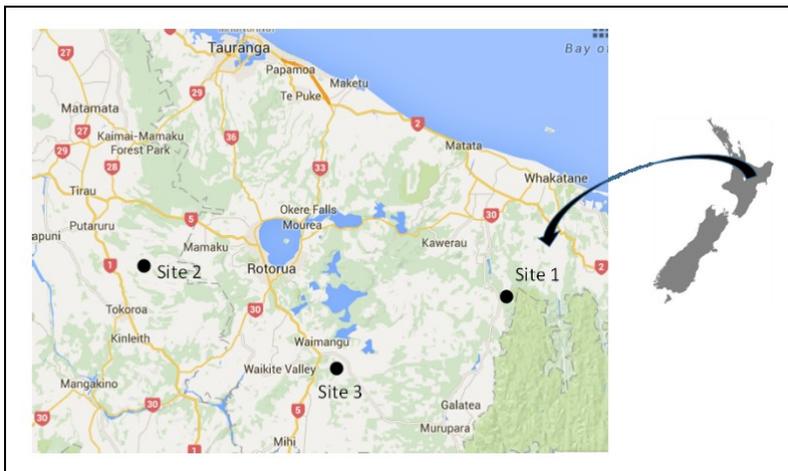
- Cuprous oxide is used fungicidal treatment for the control of Dothistroma
- Copper is a naturally occurring element, essential for all living organisms
- Cuprous oxide on the Forest Stewardship Council (FSC) highly hazardous pesticide list (2015) - toxicity to aquatic organisms
- Consequences of inability use copper
- FOA asked Scion to undertake a field study to assess the aquatic fate of cuprous oxide when aerially applied using current technologies.



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We monitored copper in waterways after aerial spraying at three sites



- The sites had:
 - Similar geology & soils
 - Topography ranging from strongly rolling to steep
 - Age classes from 4 – 15 year
- Aerial application cuprous oxide mid-November



Monitoring

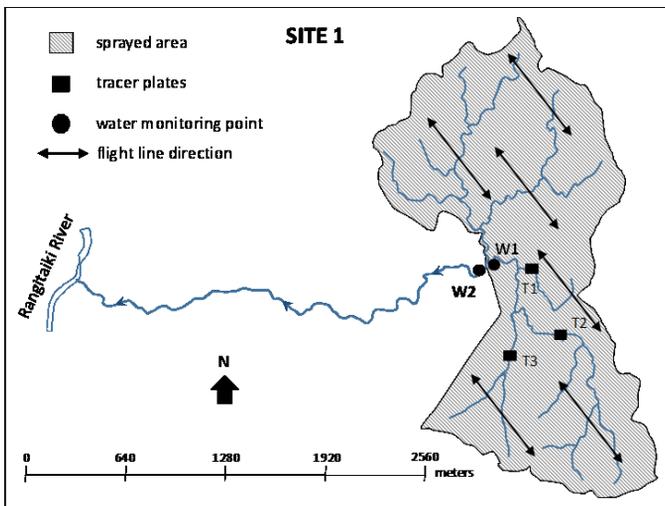
- Tracer plates were used to measure amount of copper reaching water surface
- Stream water and sediment were sampled for three months afterwards



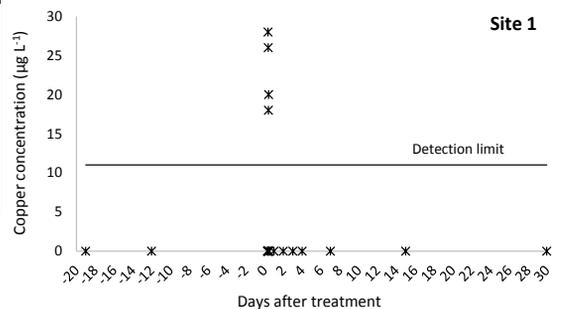
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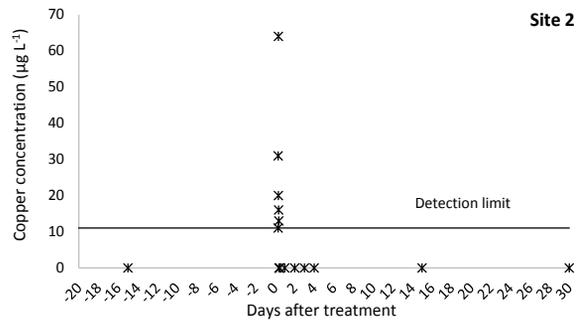
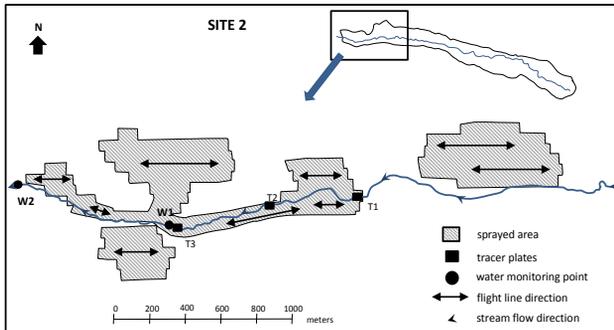
Site 1: 213 ha of 4-year-old trees treated, 100% catchment



- Lowest copper concentration on the tracer plates

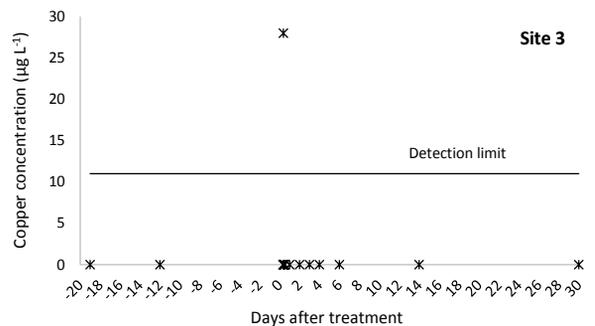
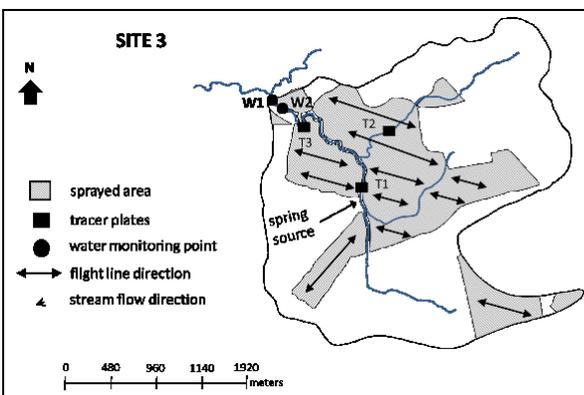


Site 2: 67 ha of 8-9 year-old trees treated, 5% catchment



- Highest copper concentration on the tracer plates

Site 3: 514 ha of 15 year-old trees treated, 72% catchment



- Copper concentration on the tracer plates mid-way between the other 2 sites

Copper in waterways results



- Copper was only detected for a few hours on the day of application
- NZ drinking water standards (2,000 ug L⁻¹) *not exceeded*
- FSC standard (LC₅₀ 18.9 ug L⁻¹ for 48 hours) – *concentrations exceeded the level but for less than 2 hours*
- ANZECC interim sediment quality guideline trigger values *not exceeded*

- Under today's operational conditions and technologies the risk to the aquatic environment from copper appears to be low for these sites
- Provides supportive data to FSC for continued operational use of copper in NZ's planted forests for Dothistroma and Red Needle Cast
- Supports industry Licence to Operate



Acknowledgements

Stream recovery

- Funding: Scion, Hancock Forest Management (NZ) Limited, Matariki Forests, PF Olsen Limited, Forest Owners Association Forest Levy Trust, & Bay of Plenty Regional Council.
- Field assistance: Robin Black, Nga Whenua Rahui staff & others.
- Stephen Moore & Stephen Pohe - aquatic invertebrate identification
- We would also like to thank the Houpoto TePua committee of management for their support of this project.

Copper in waterways

- Funding: New Zealand Forest Owners Association and the Dothistroma Control Committee.
- We would like to thank Timberlands Limited and Hancock Forest Management (NZ) Limited for the logistical support they provided.
- Heli Resources Limited applied the copper treatment to the trial sites.
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- Lindsay Bulman, management, advice, publication reviews





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