From Forest Nursery Notes, Winter 2010

**55. © Modelling the time course of shade, temperature, and wood recovery in streams with riparian forest restoration.** Davies-Colley, R. J., Meleason, M. A., Hall, G. M. J., and Rutherford, J. C. New Zealand Journal of Marine and Freshwater Research 43:673-688. 2009.

*New Zealand Journal of Marine and Freshwater Research, 2009, Vol. 43*: 673–688
0028–8330/09/4303–0673  



# Modelling the time course of shade, temperature, and wood recovery in streams with riparian forest restoration

ROBERT J. DAVIES-COLLEY[1]
MARK A. MELEASON[2]
GRAEME M.J. HALL[3]
J. CHRISTOPHER RUTHERFORD[1]

[1]National Institute of Water and Atmospheric Research Limited
Box 11-115
Hamilton, New Zealand
email: r.davies-colley@niwa.co.nz

[2]4742 Liberty Rd #312
Salem, OR, 97302, United States

[3]315 Madras Street
Christchurch 8013, New Zealand

**Abstract** Action is increasingly being taken in New Zealand and elsewhere to restore ecological function to streams through planting of riparian zones. We used simulation modelling to explore the relative performance of three strategies to restore the riparian zone of a pastoral stream to native forest by: (1) passive regeneration; (2) planting then abandonment of a *Pinus radiata* plantation; and (3) active restoration by planting selected native trees. We linked the forest model LINKNZ with a shade and temperature model (sWAIORA), and a wood model (OSU_STREAMWOOD) to simulate recovery trajectories for key forest stream attributes in hypothetical streams (1.3–14.0 m channel width) in the central North Island, New Zealand. Both active restoration strategies outperformed passive regeneration in shade, temperature and stream wood volume for most of the simulation time (800 years). Although the abandoned pine plantation provided greatest shade initially (<100 years), active native planting provided the greatest benefits overall. In general, recovery of stream shade (and temperature) is expected within decades, is accelerated by deliberate planting, and is fastest in small streams in which thermal stress from sunlight exposure is greatest. However, full recovery of stream and riparian function may take centuries, being dependent on large trees providing wood to structure the channel.

**Keywords** riparian scenarios; simulation modelling; stream wood; light exposure; thermal regime

*M08048; Online publication date 25 June 2009*
*Received 28 August 2008; accepted 12 February 2009*

## INTRODUCTION

The degradation of streams and riparian areas along with a growing realisation of their ecological importance has prompted many resource managers to develop riparian restoration strategies (e.g., Wigington & Beschta 2000). In an overview on "river restoration", Palmer et al. (2007) summarised stream and riparian restoration projects in the United States, and suggested that effort to restore rivers and streams is increasing rapidly, although a paucity of monitoring makes the "success" or otherwise of most projects difficult to judge.

There is increasing realisation in New Zealand that agriculture, plantation forestry, and urban land uses cause diffuse pollution and ecological degradation of waters (Ministry for the Environment 2007). Interest in improving stream water quality and ecological function, particularly by providing a "buffer" between streams and land use in their catchments, has been promulgated through various guideline documents (e.g., Collier et al. 1995; Ministry for the Environment 2001). Some regional councils grant special funding to land owners for riparian action, particularly livestock exclusion by fencing and riparian tree planting, for example, Environment Waikato's "Clean-streams" programme (initiated in June 2002) (http://www.ew.govt.nz/Projects/Clean-streams/).

Riparian fencing and planting is expected to eventually improve both water quality (in the sense of water composition) and stream ecological "health" towards that of forested streams (Rutherford et al.