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**The influence of stream bed stability and channel  
dynamics on lotic ecosystems: measurement and  
methodological advances**

**A thesis presented in partial fulfilment of the requirements  
for the degree of  
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in  
Ecology  
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## Abstract

Stream bed instability is one of the major sources of physical disturbance to benthic invertebrate communities. Measurement of bed stability characteristics can be difficult and the multitude of assessment methods impedes comparability between ecological studies. This research investigated the efficiency of different measures of bed stability in characterising the relationship between disturbance and stream invertebrate community composition. It intended to provide recommendations for which technique is preferable under certain conditions and to develop and advance assessment methods of bed stability for use in stream ecology.

Bed stability was found to be highly variable within and between mountain stream reaches in the southern North Island of New Zealand. Channel dynamics are conditioned by intrinsic thresholds which reflect sediment supply and catchment connectivity. Although stream ecologists use a multitude of substrate stability measurements, each assessing a distinct subset of bed stability characteristics, a large array of methods has not yet been adopted. A literature review and subsequent empirical comparison found that the volume of scour derived from morphological budgeting, the bottom component of the Pfankuch Stability Index and distance travelled by in situ marked tracer stones had a strong link with invertebrate community composition and diversity. Consistent employment of morphological budgeting at a large number of reaches, highly variable in substrate and hydraulic conditions, requires selection of an appropriate DEM interpolation method. Amongst geostatistical and local neighbourhood approaches available in Surfer<sup>®</sup>, triangulation with linear interpolation was best suited to realistically represent channel morphology at various reaches.

The bottom component of the Pfankuch Stability Index is quick and cost-effective but is prone to observer-bias and examines only a small number of variables. Tracer stones were deemed the most suitable traditional method to measure stream bed stability relevant for invertebrate communities although it can be laborious and expensive when many sites are involved. Consequently a new descriptive survey protocol (SBSI) was developed that measures invertebrate community response to bed stability. Furthermore, a macroinvertebrate index for assessment of bed stability based on taxa abundance weighted composition of the entire community is proposed. These new methods can facilitate monitoring the effect of physical disturbance on lotic ecosystems and could serve as a powerful tool in river management.



## Thesis structure and note on authorship

This thesis consists of a series of manuscripts, each written for publication in relevant journals. Thus, there is some repetition among the chapters, in particular in the methods sections and site descriptions. Also the numbering of figures and tables restarts for each chapter and some journal specific constrictions (e.g. length of abstract) were retained.

I carried out the entire field work on 48 sites and measured bed stability at six additional sites. I completely conducted the laboratory analysis of the collected samples and I wrote all texts compiled in this thesis. However, manuscripts are co-authored to acknowledge the input of others to the PhD project as appropriate. My supervisors Ian Fuller, Mike Joy and Russell Death contributed to developing the project concept, providing project funding and gear, editing manuscripts and giving general scientific advice. Jonathan Tonkin, a fellow PhD student and co-author of Chapter 5, contributed invertebrate data from six sites on the Central Volcanic Plateau to increase the database for development of a new bed stability measure.

Signed by all involved co-authors:

Russell Death




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Ian Fuller




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Mike Joy



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Jonathan Tonkin



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