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The effects of productivity and disturbance on diversity in stream communities

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Abstract

The application of conventional diversity models in streams has had limited success as stream communities often fit outside the model assumptions. Of the plethora of influences on stream macroinvertebrate diversity, productivity and disturbance dominate. Yet there remains to be a consensus on the form of these relationships and whether productivity and disturbance interact to predict diversity. Therefore, the aim of this thesis was to assess linkages between productivity, disturbance and diversity in stream macroinvertebrate communities and further the understanding of these links. I achieved this through multiple assessments throughout New Zealand (NZ) and Spain between February 2007 and December 2009. I (i) assessed multivariate models of productivity-disturbance-diversity within NZ streams and examined whether canopy presence modulated these links and (ii) whether land-use affected these relationships. I further assessed (iii) the productivity-diversity relationship in Spanish streams and whether this was underpinned by specific periphyton-invertebrate associations and (iv) if the relationship matched those of NZ and formed a global trend. Finally, I experimentally examined (v) the influence of spatial scale on productivity- and disturbance-diversity relationships. The prevailing premise throughout the thesis is that diversity increased with increasing productivity and declined with increasing disturbance, although the form of these links varied. There was no evidence of a productivity-disturbance interaction throughout this thesis and these relationships were not affected by land-use but were by canopy presence. Where relationships with productivity lacked, I demonstrate this link may be underpinned by interactions between invertebrates and specific forms of algae, as well as simply being a function of the range of productivity assessed or even the spatial scale of assessment. In fact, productivity setting the upper limit to richness may be a universal pattern in streams with no evidence of productivity leading to greater competitive interactions despite the wide ranges assessed. Overall, this thesis makes significant progress in clarifying these relationships in streams. I provide further evidence suggesting the DEM does not apply in stream communities and clearly demonstrate additive, rather than interactive, effects of productivity and disturbance.

*To my parents
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who have given me the strength to undertake such a monumental task
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Thesis structure and authorship

This PhD thesis is a combination of five individual papers written as manuscripts for publication in refereed journals, in addition to the general introduction and synthesis. This has led to unavoidable repetition in some of the content between the five chapters, especially in the methods sections. Also, the numbers for all figures and tables restart for each chapter. Papers are co-authored in order to acknowledge significant contribution towards the paper including input into the original thesis concept, designing the research, administration, and editing manuscripts. Chapter 2 “Do productivity and disturbance interact to modulate macroinvertebrate diversity in streams?” has been submitted to *Oikos* and is co-authored by Russell Death and Kevin Collier. Chapter 3 “Consistent effects of productivity and disturbance on diversity between landscapes” has been submitted to *Ecology* and is co-authored by Russell Death. Chapter 4 “Productivity-diversity relationships in streams and the role of periphyton assemblages” has not been submitted to any journal but will be co-authored by Russell Death and Jose Barquin, as will Chapter 5 “Global patterns in stream diversity – productivity relationships”. Chapter 6 “Scale dependent effects of productivity and disturbance on diversity” has not been submitted for publication but will be co-authored by Russell Death. For all chapters in this thesis, my input was the greatest. I planned the research, carried out the field and lab work, analysed all of the data and wrote all of the content.

Signed by all involved co-authors:

Russell Death



Kevin Collier



Jose Barquin



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Co-authored published paper	
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