Project Proposal Word Draft

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# Keywords

Bacterial, aquatic, multiple stressors, pollution, community ecology, honking great robots

# Project Introduction

It is well known that anthropogenic climate change – a predicted average increase of 2°C by the end of the 21st century (IPCC, 2014b) – will affect ecosystems around the world at all levels. Despite the apparently simplicity of this prediction, it has proved difficult to generalise how ecosystems will respond to changes in temperatures, particularly when taking into account their simultaneous interaction with hundreds of other stressors (IPCC, 2014a).

Freshwater ecosystems are likely to prove a crucial but vulnerable aspect of this issue in the coming decades, due to their near-universal importance to humans and wildlife alike. In particular, initial experimentation on freshwater ecosystems has shown that protracted exposure to heat can alter ecosystems considerably, increasing the prevalence of smaller organisms, reducing standing biomass, and increasing turnover rates (Yvon-Durocher *et al.*, 2011). However, applying this kind of knowledge to make more general predictions about the future of freshwater ecosystems is difficult, and research on the interaction between temperature and specific stressors is needed to tease apart community responses.

A natural laboratory of sorts for the study of bacterial responses to temperature increases can be found in Iceland’s many volcanically-heated springs. Samples of bacterial communities taken from these springs have experienced long-term exposure to elevated temperatures between about 5 and 50°C over long periods of time. By exposing different temperature-adapted communities of bacteria, as well as a mixture of hot and hold adapted bacteria, to different temperature treatments and stressors we hope to assess how bacterial communities will respond to stress under future warming scenarios.

# Proposed Methods

Initial Investigation

In order to keep lab workload within reasonable bounds for an MSc thesis, this project proposes to use a somewhat limited set of environmental conditions. Iceland-sourced isolates from across temperature gradients will be classified into those with cold or warm life histories, and a third experimental group produced from a mixture of the prior two. These communities will then be cultured (?) using an RDP method that I don’t understand, and can’t find info on anywhere online – first row of a plate will have 8 wells of 1 sp., then 7 of 2, and 6 of 3, right up to 1 of 8.

Identical communities will then be exposed to various combinations of three stressors: temperature, in the form of cold treatments, warm treatments, and both of the above plus an ‘extreme event’, and variously no additional stressors, additional stressors 2, 3, or 2 and 3 in combination.

Follow-up Studies

Nutrient-mediated stress?

* Plan to use (Thompson, MacLennan and Vinebrooke, 2018)’s proposed improved null model – but I need to keep an eye out for any criticisms, as it’s only just been published

# Anticipated Outputs and Outcomes

This study will, if successful, develop understanding of how communities with different histories of chronic temperature stress respond to stressors and combinations of stressors. If circumstances permit, it will also examine how different responses to stress are mediated by nutrient availability.

# Project Feasibility and Timeline

Through use of the Bell microbiology lab’s high-throughput liquid-handling and community measurement robots it should prove possible to complete the relatively high number of exposures needed to test a variety of bacterial communities against a variety of conditions, with a high level of replication.

GANTT Chart

# Budget

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# References

IPCC (2014a) *Climate Change 2014: Impacts, Adaptation and Vulnerability - Contributions of the Working Group II to the Fifth Assessment Report*. Cambridge University Press. doi: 10.1016/j.renene.2009.11.012.

IPCC (2014b) *Climate Change 2014 Synthesis Report Summary Chapter for Policymakers*. doi: 10.1017/CBO9781107415324.

Thompson, P. L., MacLennan, M. M. and Vinebrooke, R. D. (2018) ‘An improved null model for assessing the net effects of multiple stressors on communities’, *Global Change Biology*, 24(1), pp. 517–525. doi: 10.1111/gcb.13852.

Yvon-Durocher, G. *et al.* (2011) ‘Warming alters the size spectrum and shifts the distribution of biomass in freshwater ecosystems’, *Global Change Biology*, 17(4), pp. 1681–1694. doi: 10.1111/j.1365-2486.2010.02321.x.

# Appendix I: Tabulated Budget

* Needs to be signed off by Emma

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