Impact - Ecosystem responses to escalating drivers: linking species interactions and resilience

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The overall objective of my proposed research is to expand our current understanding of the ecosystems response to multiple anthropogenic drivers and their cumulative impacts. In particular, I will focus on the role played by networks of species interactions have in the resilience of ecosystems.

To explore these questions I will focus on model systems and drivers that have global relevance but are particularly important for New Zealand ecosystems. Specifically I will focus on 1) mutualistic plant-pollinator networks which are pivotal for biodiversity maintenance and crop production 1,2; and 2) biotic invasions and defaunation, that are a significant component of human-caused global change for which New Zealand is notably vulnerable3. However, the theoretical and quantitative approach I will use will allow for my results to be applicable to other processes, ecosystems and drivers.

Birds and insects pollinate about two thirds or New Zealand’s plants, including iconic native plants (like kowhai and pohutukawa) and economically important crops (like kiwifruit, apples and grapes). New Zealand flora is particularly vulnerable to declines in pollination services4, yet those services have been distorted by the introduction of foreign bees5, and the population depletion of native birds6,7. Also, in contrast with other locations, pollination networks in New Zealand are dominated by generalist species8,9---plants that attract a wide range of pollinator species and pollinators that visit a wide range of plants. The research I am proposing here will help elucidate if and how these structural differences affect the resilience and stability of New Zealand's pollination systems when considering that original ecosystems have been changed by biotic invasions. Understanding how invasions interact with defaunation in ecological networks is a global research priority, and essential for conserving, restoring and managing New Zealand ecosystems4.

It has been recently shown that the architecture of empirical and simulated interaction networks mediates the response to drivers such as defaunation and species invasions, and increases the communities’ ability to support greater numbers of species10–14. However, few studies have investigated the link between species interactions and resilience in the context of human-caused drivers15,16. Thus, my proposed research aims to fill this gap and to answer several research questions that emerge when network theory is combined to resilience and critical transition theory.

My PhD is being conducted in [Daniel Stouffer's lab](http://www.stoufferlab.org/)---a Rutherfurd Discovery Fellow at the University of Canterbury. His group is internationally active and has several current visiting scientists, for example from the Universidade de Sao Paulo (Brazil), the Ecole normale superieure (France) and the University of Western Sydney (Australia). My proposed project also aligns nicely with the interests of several prominent researchers: [Jason Tylianakis](http://www.tylianakislab.org/) (University of Canterbury), [Jordi Bascompte](http://www.bascompte.net/) (University of Zurich), [Martin Scheffer](http://www.sparcs-center.org/) (Wagenigen University), and [Carl Folke](http://www.stockholmresilience.org/21/contact/staff/1-15-2008-folke.html) (Stockholm Resilience Center). I am already incontact with some of them and collaborations seem highly likely.

Many ecosystems respond non-linearly to global change and human activities. When stressors reach a tipping point, ecosystems collapse and enter into a new undesirable regime. By using fundamental ecological theory and quantitative approaches I aim to contribute to our understanding of how to predict and prevent these undesirable shifts, and most importantly, how to recover from them. With your support, I will tackle fundamental, globally important, ecological questions that are of especial relevance for New Zealand's natural heritage and agricultural sector.

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