The importance of interaction strength for food web dynamics and ecosystem functioning

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PhD Thesis

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Declaration:

This PhD thesis is my own work and has not been submitted for another degree, either at University College Cork or elsewhere.

Eoin O'Gorman

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This thesis is dedicated to Moira and Fr. Mac.
I would give anything for you to have seen me finish.
But I felt your helping hands every step of the way.

"*The scientist does not study nature because it is useful.*
He studies it because he delights in it, and he delights in it because it is beautiful.
If nature were not beautiful, it would not be worth knowing.
And if nature were not worth knowing, then life would not be worth living."

– Jules Henri Poincaré

Abstract of PhD Thesis

Global biodiversity is eroding at an alarming rate, through a combination of anthropogenic disturbance and environmental change. Ecological communities are bewildering in their complexity. Experimental ecologists strive to understand the mechanisms that drive the stability and structure of these complex communities in a bid to inform nature conservation and management. Two fields of research have had high profile success at developing theories related to these stabilising structures and testing them through controlled experimentation. Biodiversity-ecosystem functioning (BEF) research has explored the likely consequences of biodiversity loss on the functioning of natural systems and the provision of important ecosystem services. Empirical tests of BEF theory often consist of simplified laboratory and field experiments, carried out on subsets of ecological communities. Such experiments often overlook key information relating to patterns of interactions, important relationships, and fundamental ecosystem properties. The study of multi-species predator-prey interactions has also contributed much to our understanding of how complex systems are structured, particularly through the importance of indirect effects and predator suppression of prey populations. A growing number of studies describe these complex interactions in detailed food webs, which encompass all the interactions in a community. This has led to recent calls for an integration of BEF research with the comprehensive study of food web properties and patterns, to help elucidate the mechanisms that allow complex communities to persist in nature. This thesis adopts such an approach, through experimentation at Lough Hyne marine reserve, in southwest Ireland. Complex communities were allowed to develop naturally in exclusion cages, with only the diversity of top trophic levels controlled. Species removals were carried out and the resulting changes to predator-prey interactions, ecosystem functioning, food web properties, and stability were studied in detail. The findings of these experiments contribute greatly to our understanding of the stability and structure of complex natural communities.