PhD abstract

draft only

2019-06-08

*Factors enabling native prey to persist in the face of environmental variability and predation by invasive predators*

As my PhD has evolved over the past three years I have let the scope of the work to follow the solutions rather than the particular abstract I proposed in 2016. I have expanded on my previous abstract to align with the current findings of my PhD research.

## Documents

*Add details as needed:*

* **Curently in** [**dropbox**](https://www.dropbox.com/home/phd-drafts-anthony)**:** all files can be found in this directory currently

### Notes

I think that the general overview and structure of the thesis is an important document to discuss and hash out regularly to ensure that all collaborates are on board. This is something I have done badly through my candidature and this is my attempt to round everything up to something that everyone can discuss and get on board with. As the thesis continues to develop I will modify and adjust the objectives below to address any issues or challenges. I can easily convert this information into a [bookdown document](file:///C:\PhD\phd-thesis\000Phd_overview_detail\vignettes\%22https:\bookdown.org\%22) for my thesis.

## Collaborators

*Add details as needed*

* Professor [Richard Duncan]
* Professor [Roger Pech]
* Dr [Wendy Ruscoe]
* Dr [Dean Anderson]
* Professor [Ross Thompson]
* Dr [Bernd Gerber]

## Working title

*Controlling invasive predators at a national scale. Modelling and communicating the complex factors enabling native prey to persist in the face of environmental variability and predation by invasive predators.*

# Abstract

*Will remove references later but here to make referring to these key papers easy.*

This document is the core of my phd that makes the whole section of work fit together, including to some degree the Statistics Network and other projects. I haven’t posted any of it on the website yet as I am a bit protective of these collection of ideas.

### v1

*These are the key points and supporting literature in a logical order for my thesis.*

* The cause of drastic declines in native biota globally has been attributed to predation by invasive mammals (Innes et al., n.d.)
* As well as changes spatial and temporal environment (Scheffer et al. 2001).
* Or a combination of the above effects (van der Plas et al. 2019)
* And this is worse for native biota on Islands (Holmes et al. 2019) and across Australia (e.g weeds (Williams and West 2000)) and New Zealand ([Conservationism article](https://theconversation.com/despite-its-green-image-nz-has-worlds-highest-proportion-of-species-at-risk-116063)) because of high levels of endemism.
* Targets to reverse the decline of native species commonly focus on the management of predators (Doherty et al. 2016; Holmes et al. 2019).
* To the extent that New Zealand has built policy (Linklater and Steer 2018) and advocacy/funding (Russell et al. 2015) to support national targets aimed at removing invasive predators.
* Managers also consider the complexity of additive and synergistic effects of species interactions that can create an array of threats (Brashares et al. 2010; Courchamp, Frank 1999; Doherty et al. 2016).
* Ecologists do this by (data chapters) == statistical modelling (Jørgensen and Bendoricchio 2001). Overall, simple, multi-species interactions (e.g. [DOC beech figure](https://www.doc.govt.nz/our-work/tiakina-nga-manu/predator-plague-cycle/)) are estimated using simulation (e.g Courchamp, Frank 1999) and small scale experiments (Blackwell et al. 2003).
* However, there are still many complex multi-species modelling challenges (Ruscoe et al. 2011, 2012).
* While historically the focus of threatened species management has been on the vulnerability of native biota (e.g. ODonnell and Phillipson 1996), this PhD aims to shift this focus from vulnerability to persistence with an emphasis on enhancing species strengths (persistence in the environment; (Ruscoe et al. 2012)) not weaknesses (vulnerability to threats).
* In combination with the unexpected outcomes of predator control (Ruscoe et al. 2011; Tompkins and Veltman 2006) and complex modelling, managers must also allocate resources that are restricted by funding and other anthropological drivers.
* For managers and in particular, the national leaders of PFNZ2050 (Russell et al. 2015) already communicate and utilise nation-wide community groups to successfully manage invasive species in NZ native forests and nationally into the future.
* To be able to verify and implement the models with community and citizen science groups I have developed a unique combination of open-source tools (British Ecological Society 2018; Grieves 2017) that allow reproducible science for a wide range of new and pre-exsisting researchers and community groups.
* I combine this reproducible framework with complex bayesian models to investigate the interactions between multiple interacting invasive species using existing data on the abundance, survival and persistence of native biota (e.g. Choquenot and Ruscoe (2000); Ruscoe et al. (2011); Ruscoe et al. (2012); J Griffiths unpublished data)\*.
* We estimate population dynamics of invasive species in different forest types and under different predator control regimes.
* Given the current scientific environment (Laundré et al. 2014) (with direct reference to applied ecology (Pettorelli et al. 2019)) a need for new scientific tools for PFNZ-2050 is evident (Russell et al. 2015).
* In a landscape of fear, both ecologist and the species we study are under a new and unique set of conditions. This thesis will provide a new and groundbreaking integration between Ecology and Computer Science (e.g. (Kaplan, n.d.)). Breaking down key barriars to a PFNZ-2050 (McGreavy et al. 2015).

## Justification

During my PhD candidature I have always remained focused on understanding the ecological processes that **enable native biota to persist in the face of multiple threats**.

### Evidence

The variation from this focus has been pivoted around the following:

* To understand if animals are persisting in the environment there are three approaches to understanding population dynamics:
  1. Theoretical studies
  2. Observational studies
  3. Experimental studies
* There are also three main methods to analysis the data collected from measuring population dynamics:
  1. Rates of increase
  2. Simulation
  3. Dynamic population models
* We can also use one of two broad approaches to estimation:
  1. Frequentist modelling
  2. Bayesian modelling
     + Bayesian modelling is really complex and have observed that if general users cannot understand a tool they will not use it.
* Making decisions about the type of model choice has been attributed to issues with reproducibility. This is often referred to researcher bias.
* Generally, Bayesian models are becoming a regular tool for ecologists (*cite*) but they are not without there issues (*cite*)
* Using more complex statistical models (e.g Bayesian Hierarchical Modelling) and high quality data (e.g. Capture-recapture data)
* PFNZ-2050 is a thing, published and known (Linklater and Steer 2018; Russell et al. 2015).
* Large scientific databases exsist.
  + [Global invasive species database](http://www.iucngisd.org/gisd/)
* With a national level program the general user becomes a “common citizen” and no longer a statistican.
* I have found that community driven implmentation of PFNZ-2050 will not be possible without two key steps researchers and managers need to understand and embrace:
  1. A structural change in “workflow” to **ensure** reproducibility through *completeness*.
  2. Projects build from a “open-science” philosophy to allow continued use of reproducibility.
* I have ensured that the general workflow and communication tools used are capability of simpler community driven models too.

My PhD develops theory for implimenting reproducibility in the overall disipline of “science” to help reduce many of the large communication gaps between national policy (Russell et al. 2015) and community groups and organisations.

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