

# Merging theory and practice in the ecology of the Anthropocene

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# Outline



## 1 - Based on RILHAS Workshop motivation:

*“Discuss methods to study ecological processes to fill the gaps within the context of global modifications in the Anthropocene”*

1. I will defend the idea that theory should walk closer to practice
2. suggest ways to tackle impacts by putting them into general ecological theories
3. exemplify this approach using interesting studies of modern coexistence theory

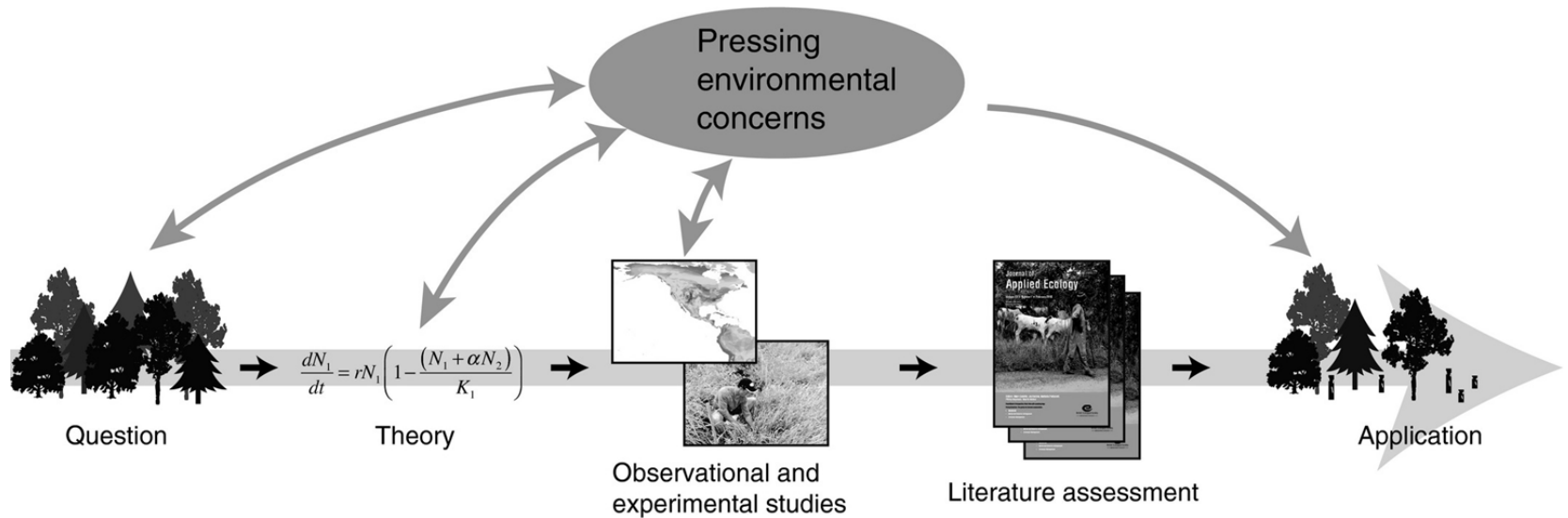
EDITORIAL

**Solving environmental problems in the Anthropocene:  
the need to bring novel theoretical advances into the  
applied ecology fold**

Marc W. Cadotte<sup>\*,1,2</sup>, Jos Barlow<sup>3,4</sup>, Martin A. Nuñez<sup>5</sup>, Nathalie Pettoirelli<sup>6</sup> and  
Philip A. Stephens<sup>7</sup>

*“Translating global awareness and concern into effective policies  
requires **sound science** to inform management decisions”*

1. Problems in the Anthropocene can be tackled with **ecological knowledge**
2. Applied Ecology is not a field **within** Ecology, it can be the **final outcome** of all ecological fields



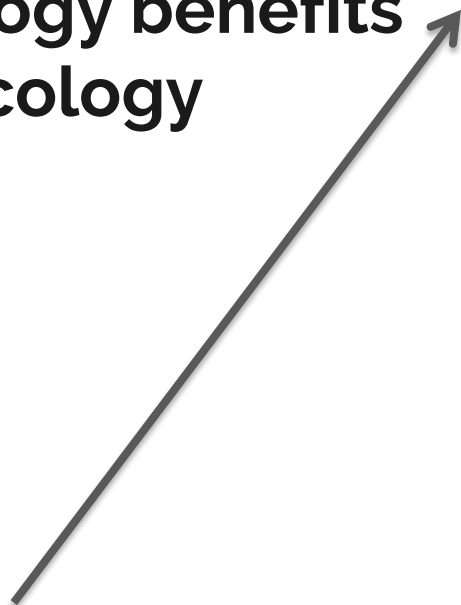
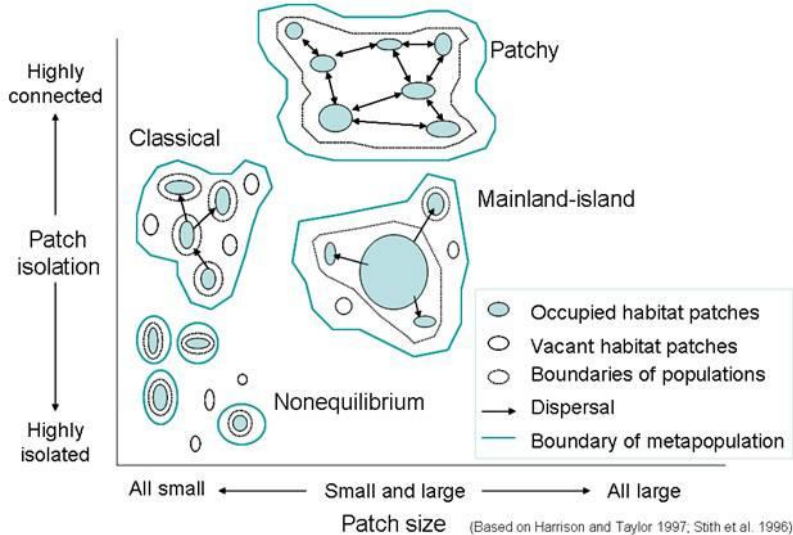
The theory-to-application pipeline in ecology

Just like ecology, applied ecology spans all spatial and temporal scales, levels of biological organization and interactions among these – so, we can use all theories to do both applied and basic ecology

# Applied ecology benefits from basic ecology advances



## Metapopulation structure



# Why not all theories are being applied, as metapopulation theory?

## 1. The theory application time-lag

Strong support for a theory takes time

Urgent needs cannot wait too long

- A. Metacommunity ecology is an example
- B. Metapopulations can model population persistence

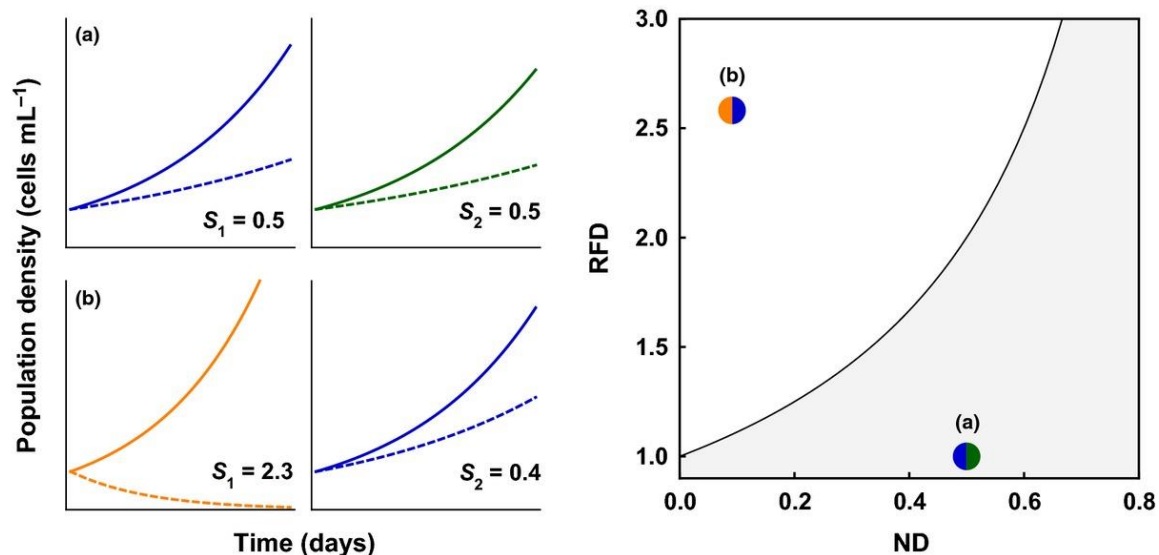




## 2- Theoretical studies are sometimes hard to understand - models with hard to measure parameters (Chesson 2000)

$$\bar{r}_i \approx b_i \left( k_i - \frac{\sum_{s \neq i} k_s}{n-1} \right) + b_i \frac{(1-\rho)}{n-1} D$$

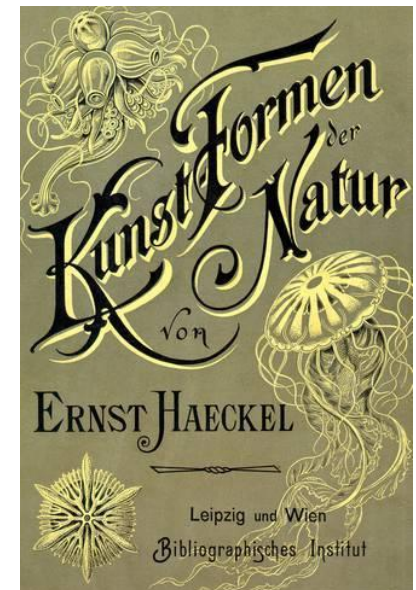
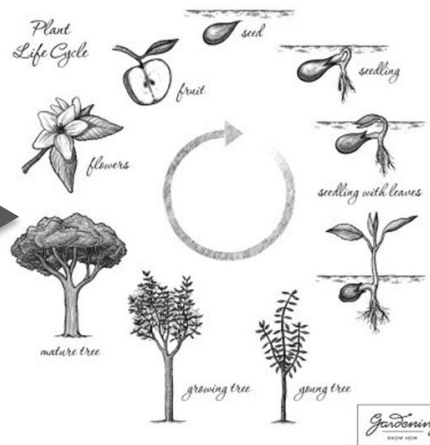
It takes time to develop ways to measure the parameters: Carroll et al. 2011, Narwani et al. 2013 - **11 years**



### 3- The data availability gap

- Sound applied ecology planning requires a data-driven evidence base.
- Theoretical parameters are based on natural history
- Basic data are badly needed - natural history
- A bigger problem for tropical sites

$$\bar{r}_i \approx b_i \left( k_i - \frac{\sum_{s \neq i} k_s}{n-1} \right) + b_i \frac{(1-\rho)}{n-1} D$$

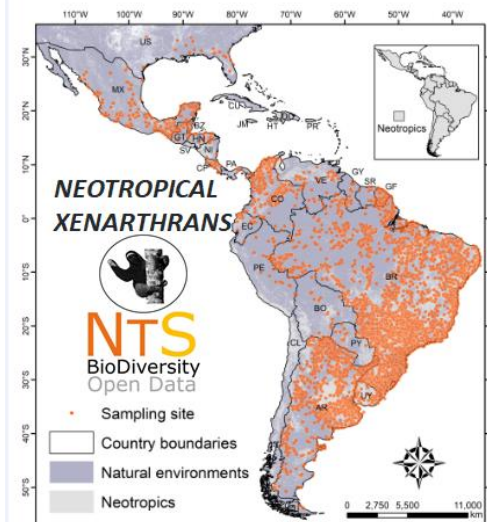






# Bridging the theory-practice gap

- Taking the most from the rare good data
- Low threshold for the number of positive tests of theory needed before designing applied ecology studies that assess management options
- Designing and writing basic studies with applications in mind



# Looking into anthropogenic impacts as ecological processes

Anthropogenic impacts are basically Aldo Leopold's 'axe, plow, cow, fire and gun' + climate change, diseases, invasive species, roads

1. What are the ecological processes involved in a given impact?
2. Which theories investigate such processes?
3. How is the state-of-the-art of this theory?
4. How can I use such advances in applied studies?

What ecological processes are equivalent to an invasion of an exotic species?

What are the theories (basic ecology) dealing with these processes?

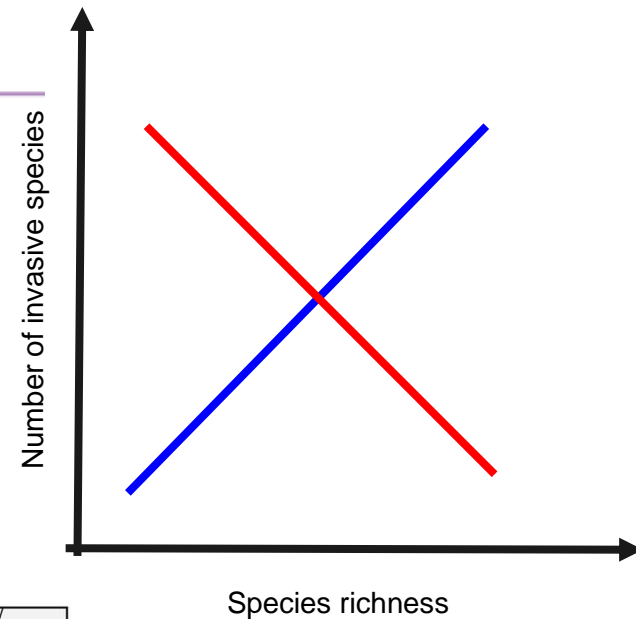
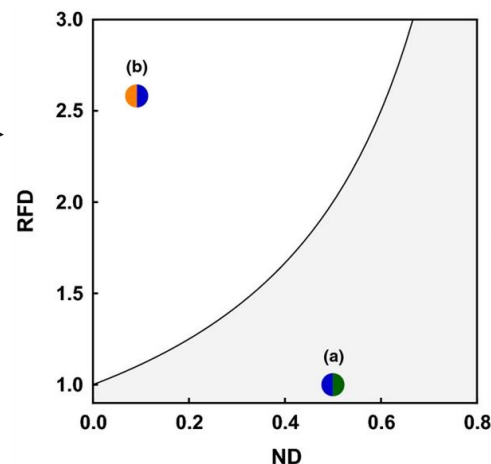


*Macrobrachium  
rosenbergii*

# Community ecology theory as a framework for biological invasions

Katriona Shea and Peter Chesson

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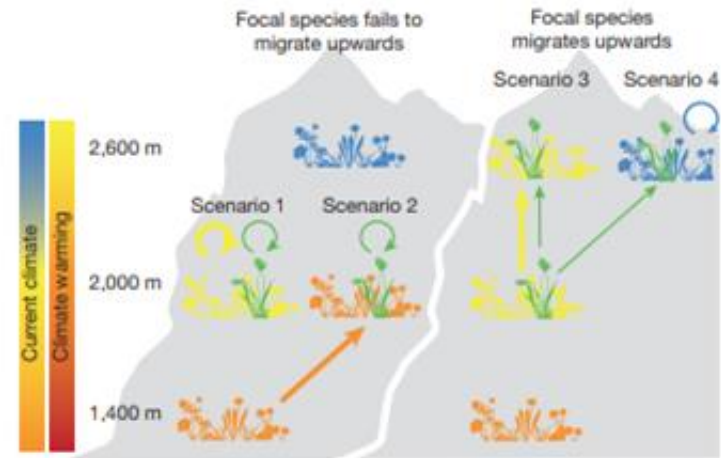
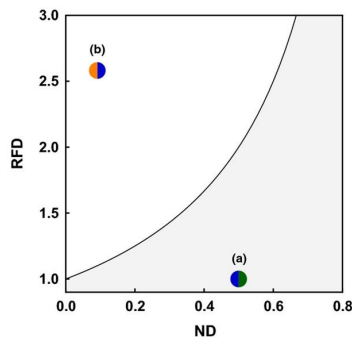


Solving an empirical paradox

# Coexistence theory and climate change

Alexander, J.M., J.M. Diez, and J.M. Levine. 2015. Novel competitors shape species' responses to climate change. *Nature* 525:515-518.

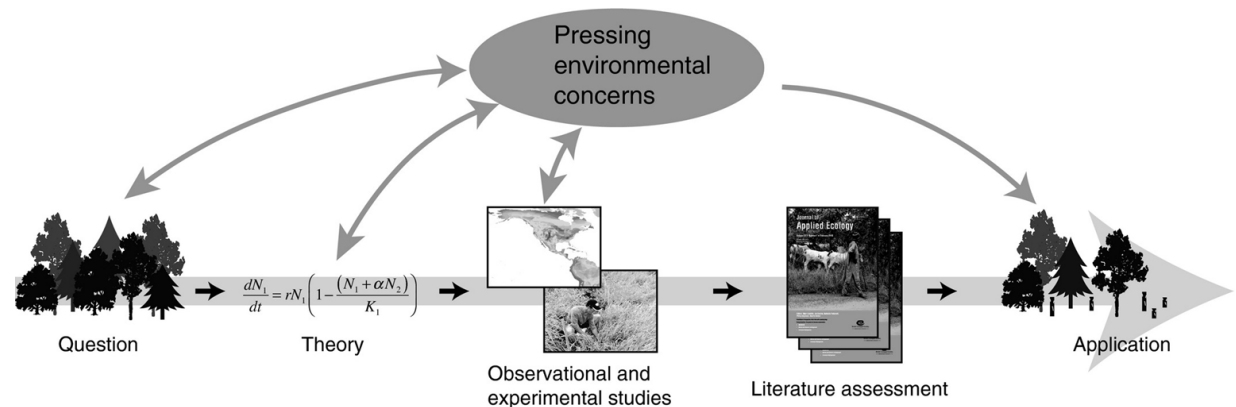
- Species will change their ranges with climate change
- Species will be involved in novel interactions
- Species will not change their ranges - interactions in new conditions



**Figure 1 | Scenarios for the competition experienced by a focal alpine plant following climate warming.** If the focal plant species (green) fails to migrate, it competes either with its current community (yellow) that also fails to migrate (scenario 1) or, at the other extreme, with a novel community (orange) that has migrated upwards from lower elevation (scenario 2). If the focal species migrates upwards to track climate, it competes either with its current community that has also migrated (scenario 3) or, at the other extreme, with a novel community (blue) that has persisted (scenario 4). Table 1 describes the experimental implementation of these scenarios.

# Wrapping up

- Applied ecology is the final outcome of ecological knowledge nowadays
- Not all theories are being used in applied ecology
  - Time lag - Hard theories - Lack of data - Scale mismatch
- There are ways to facilitate the incorporation of theoretical advances
  - Data repository - Well designed studies - Impacts as ecological processes
- Merging theory and practice will help management in the Anthropocene



The theory-to-application pipeline in ecology





# Thank you for your attention!

*“Theory without data is myth, data without theory is madness”*

Phil Zuckerman

Thanks to Marcos Callisto and colleagues for the invitation

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