Managing dynamic and unpredictable species invasions

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How important are invasions?

IPBES 2019 Global Assessment Report on Biodiversity and Ecosystem Services
Similarities & differences between species invasions and responses to climate change
Species invasions

Climate change
1. What are the effects of invasive species on native communities?

2. What does it mean that invasions are dynamic?
Studies on invasion biology increasing
In particular: what is the relationship between invader abundance and impact?
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Global meta-analysis of invasion impacts
• 1,258 empirical studies (from 201 publications)
• contained at least 4 invader abundances
• responses: (i) native species abundance; (ii) community responses (diversity, richness, etc)
In particular: what is the relationship between invader (IAS) abundance and impact? And does trophic level matter?

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IAS = Invasive alien species

Bradley et al. 2019, *PNAS*
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Bradley et al. 2019, PNAS

![Graph showing native response against IAS abundance with regression equations for Evenness, Diversity, and Richness.](image)
Invasions can be dynamic in several possible ways:

- Changing abundance
- Changing gene frequencies
- Changing species interactions
- Changing impacts

modified from Strayer et al. (2017)
Example: Plant-soil feedbacks can control abundance

Klironomos et al. 2002, Nature
Do plant-soil feedbacks become more negative over time?

- 1340 plots (36m$^2$) across the Peninsula
- Variation in arrival times of non-native plants & relative abundance
Do plant-soil feedbacks become more negative over time?

Study Species

Ac – Anthriscus caucalis
As – Arenaria serpyllifolia
Ca – Cerastium alpinum
Cc – Crepis capillaris
Cg – Cerastium glomeratum
Da – Dianthus armeria
Dd – Dianthus deltoides
Ls – Lactuca serriola
Se – Sisymbrium erysimoides
So – Sisymbrium officinale
Sm – Stellaria media
Va – Veronica arvensis
Yes: Novelty advantage declined over time

Do invasions take care of themselves?

*Now you see them, now you don’t! – population crashes of established introduced species*

Daniel Simberloff* & Leah Gibbons

Some studies show “boom bust” but mechanisms are largely unknown

Strayer et al. (2017) Ecology Letters
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And secondary invasions may be common.
What does this mean for management?

“…seems particularly unwise to adopt a ‘do nothing’ management strategy based on the assumption that problematic non-native species will soon go away on their own.”

Strayer et al. (2017) Ecology Letters
Optimal strategy changes over time

Prevention
- Information
- (Self)regulation and legislation
- Quarantine measures

Early detection
- Interception
- Monitoring and surveillance
- Removal

Management
- Eradication
- Containment
- Control

Management efficiency
- Impact
- Detectability
- Management cost

TRENDS in Ecology & Evolution

Simberloff et al. TREE 2013
Concluding thoughts

- Invasions are dynamic
- Abundance matters for impacts!
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Bad news
- We still lack good long-term data
- Management is not a job that will ever be done.
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Good news
- the longer invasions happen, the more long-term data we get!
- Social media, citizen science, etc. = more and more distributed and long-term data
- Management efforts are an important counter-balance to the forces of homogenization.
Thank you

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