The paradox of biological invasions

Corum, Montpellier
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Christophe Diagne & Franck Courchamp
“Process by which non-native species are introduced and successfully establish in a new ecosystem where they may cause detrimental impacts” (CBD, 2009)
Biological invasions: which species, where?

883 IAS recorded
Biological invasions: which species, where?

~ 14,000 exotic species

~ 3,182 exotic species (France)
Biological invasions: which species, where?

Figure 1. Spatial distribution of IAS-threatened (CR, EN and VU IUCN Red List) mammals, birds, reptiles and amphibians, in absolute number (a) and given as a proportion of all threatened species (b). For instance, a proportion of 50% for a given location means that 50% of the threatened species there are threatened by IAS.
Invasive alien species: detrimental impacts worldwide

- Biodiversity and ecosystems
- Public health
- Human well-being
- Socio-economic activities
Invasive alien species: detrimental impacts worldwide

- Major cause of recent extinctions
- 2nd most important threat on biodiversity

- Competition, predation, habitat destruction, overconsumption, disease transmission,...

- Biodiversity and ecosystems
- Public health
- Human well-being
- Socio-economic activities
Invasive alien species: detrimental impacts worldwide

- biodiversity and ecosystems
- public health
- human well-being
- socio-economic activities

Tiger mosquito
\((Aedes albopictus)\)

- vector of human diseases (e.g. yellow fever virus, dengue, Chikungunya and about thirty other viruses)
Invasive alien species: detrimental impacts worldwide

- biodiversity and ecosystems
- public health
- human well-being
- socio-economic activities

- expensive power outages and electrical damage

Brown tree snake
(Boiga irregularis)
Invasive alien species: detrimental impacts worldwide

- damage to **food stocks and crops**
- economic **losses to industries**

**biodiversity and ecosystems**

**public health**

**human well-being**

**socio-economic activities**
Invasive alien species: detrimental impacts worldwide

- biodiversity and ecosystems
- public health
- human well-being
- socio-economic activities

- impacts on biodiversity, agriculture, cattle breeding, and anaphylactic shocks

Red fire ant
(Solenopsis invicta)
Paradox of biological invasions

Invasive alien species have **huge** and **multidimensional impacts** worldwide.
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and yet, biological invasions are little known as a major problem.
Paradox of biological invasions

Invasive alien species have huge and multidimensional impacts worldwide and yet, biological invasions are little known as a major problem.
Paradox of biological invasions

Opinion
Invasion Biology: Specific Problems and Possible Solutions

Franck Couchamp,1,* Alice Fournier,1 Céline Bellard,2
Cleo Bertelsmeier,3 Elsa Bonnau,1 Jonathan M. Jeschke,4,5,6
and James C. Russell1,7

24 specific issues that make it more difficult to
Paradox of biological invasions

Trends in Ecology & Evolution

Opinion
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24 specific issues that make it more difficult to
Paradox of biological invasions

• Invasion debt (50 years!)
• How do you measure impact?
• Who cares about ecological impacts anyways?
• Changes are usually gradual, tending to pass unnoticed
• Difficult/impossible to quantify and demonstrate a change
Paradox of biological invasions

Understanding
- Poorly understood concepts
  - Lack of scenarios
  - Blurry definitions
  - Blurry concepts
  - Evolving concepts
  - Field-specific frameworks

- Difficult measurement and demonstration of impacts
  - Difficult quantification of system evolution
  - Lack of general rules
  - Local scale interests
  - Lack of knowledge on many systems
  - Multifaceted threat

Supporting
- Confusion between invasive & introduced
- Sympathy for many IAS
- Reluctance to kill
- Invasion biologists seen as biased
- Recommendations seen as constraints to liberty
- Actions indirectly positive
  - Most cases are local problems
  - Lack of iconic victim

Alerting
- Blurry legal frameworks
- Heterogeneous legal frameworks
- No definitive success
- Twisted Tragedy of the Commons

Implementing
- International trade industry
- Civil society
  - Public sector
  - Tourism industry
- Lawyers
- Local communities
- Policy makers
- State and federal agencies
- Animal rights societies
- Green industry
- Hunting industry
- Foresters
- Natural area managers
- Academia
- Conservation organizations

Figure 2. Different Types of Stakeholders with which Invasion Biologists Interact. Their position regarding biological invasions is not always in consensus and can be context-specific.
Biological invasions: why studying their economic costs?

One way to quantify impacts, but also to touch non-scientists is to use metrics that they are familiar with: **currencies**

Courchamp et al. 2017 *TREE*
Biological invasions: why studying their economic costs?

- Currency: a common and understandable metrics
  - Economic costs
    - Damage and losses
    - Management expenditures

Bradshaw et al. 2016 *Sci Rep*
Courchamp et al. 2017 *TREE*
Biological invasions: why studying their economic costs?

Difficult measure & demonstration of impacts
- Difficult anticipation of system evolution
- Lack of general rules
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Alerting

Currency: a common and understandable metrics

Economic costs
- Damage and losses
- Management expenditures

improve public communication and compel policymakers

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**Currency:** a common and understandable metrics

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Alerting

**Economic costs**

- Damage and losses
- Management expenditures

**Support** efficient and cost-effective decision-making

**Improve** public communication and compel policymakers

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Biological invasions: why studying their economic costs?

Currency: a common and understandable metrics

Economic costs

Damage and losses

Management expenditures

Alerting

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improve public communication and compel policymakers

support efficient and cost-effective decision-making

increase prioritization in the global environmental agenda
Paradox of biological invasions

**Difficulties**

**Understanding**
- Poorly understood concepts
  - Lack of scenarios
  - Blurry definitions
  - Blurry concepts
  - Evolving concepts
  - Field-specific frameworks
- Difficult measure & demonstration of impacts
  - Difficulty in integration of system evolution
  - Lack of general rules
  - Local scale interests
  - Lack of knowledge on many systems
  - Multifaceted threat

**Supporting**
- Confusion between invasive & introduced
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**Alerting**
- Change communication model
  - Focus on understudied systems
  - Focus on processes
  - Focus on global scale
  - Highlight economic impacts

**Implementing**
- Better define terms and concepts
  - Develop scenarios
  - Apply standardized definitions with rigor
  - Develop theory
- Better method standardization
- Change communication model
  - Associate with positive restoration
  - Focus on affected species, find iconic species
  - Insist on global aspect of threat rather than multitude of impacts
- Cost efficiency risk analyses to prove long term programs relevance
- Improve and standardize legal frameworks
  - Use research to underpin management
  - Research and monitoring Before & after restoration
- Use economic data
Economic costs: need of a global overview

harmonize available information & identify knowledge gaps

prioritize actions & coordinate responses at relevant scales
Economic costs: need of a global overview

- different temporal and spatial scales,
- different areas, sectors or taxa,
- different types of costs (damage vs management),
- different methodologies, currencies, ...

No possible comparisons
No general trends/patterns
No consistent approach
Economic costs: need of a global overview

harmonize available information & identify knowledge gaps

prioritize actions & coordinate responses at relevant scales

InvaCost, a public database of the economic costs of biological invasions worldwide

www.nature.com/scientificdata

SCIENTIFIC DATA

OPEN DATA DESCRIPTOR

Compile

Standardize

Describe

Analyze
Economic costs: need of a global overview

- Harmonize available information & identify knowledge gaps
- Prioritize actions & coordinate responses at relevant scales

More after the coffee break !!!