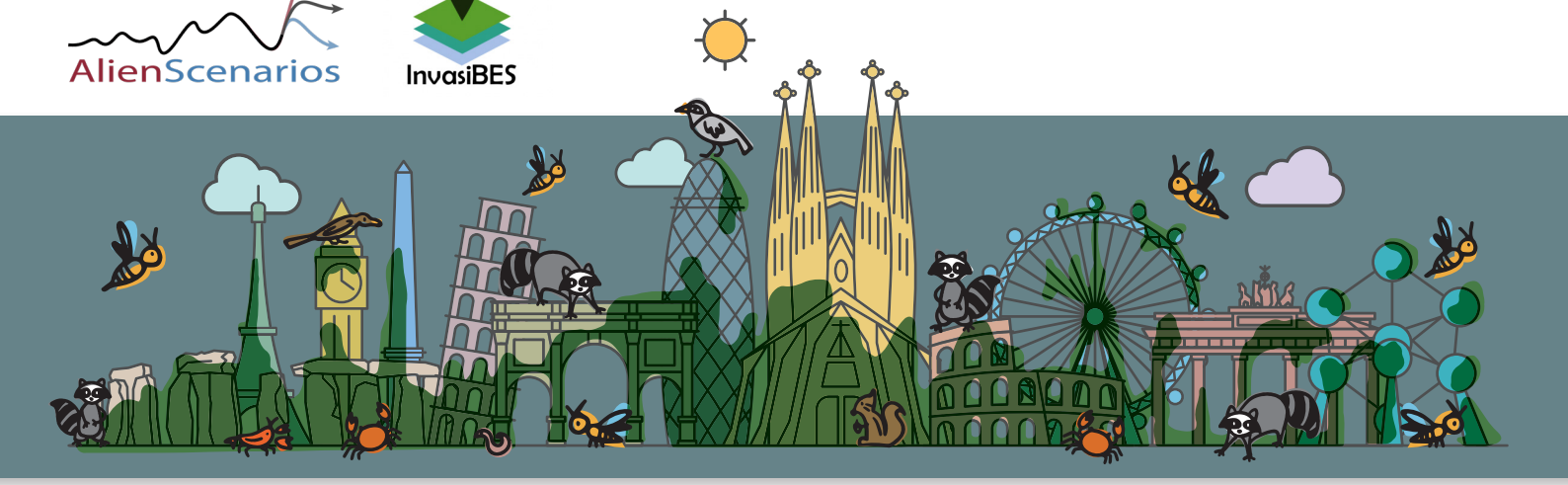
AlienScenarios

InvasiBES



THE FUTURE MANAGEMENT OF BIOLOGICAL INVASIONS IN EUROPE

Key findings and policy recommendations

- Biological invasions are a major threat to biodiversity, nature's contributions to people and human well-being, and this threat is expected to increase in the future.
- Global biodiversity assessments and climate scenarios have mostly neglected biological invasions.
- Scenarios of biological invasions can inform policy-making and deliver management strategies resilient to future environmental, socio-economic and societal changes.
- Any management strategy to reduce the harmful impacts of biological invasions in Europe should rely on multiple and inter-linked recommendations.
- Key fundamental recommendations are:
  - The establishment of an intergovernmental agreement (or body) that coordinates actions related to IAS management in Europe.
  - The development of a communication strategy and platform to increase public awareness regarding biological invasions and their management possibilities across sectors.
  - The adoption of standardised protocols to collect IAS data and facilitate its accessibility to guide management decisions.
  - The establishment of a monitoring system to assess biological invasions at the European and country levels.
- It is time to shift the focus of biological invasion management in Europe toward a more integrated perspective that takes into account different sectors and countries, and explicitly accounts for plausible future scenarios.

biodiversa
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AGENCIA ESTATAL DE INVESTIGACIÓN
GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN
Bundesministerium für Bildung und Forschung
FWF Der Wissenschaftsfonds.

Context

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) ranked invasive alien species (hereafter IAS) among the world's most important causes of biodiversity loss. IAS affect not only global biodiversity but also ecosystem integrity, nature's contributions to people and human health. These multi-dimensional impacts and their ecological, economic and societal relevance are discussed in detail in the IPBES thematic assessment on IAS and their control [1]. The assessment highlights current introduction rates of 200 new established alien species annually and an expected increase of species numbers by 36% under a business-as-usual scenario. However, realised outcomes will likely be even higher.

The European Union Regulation on IAS (1143/2014) has brought together and enhanced the separate efforts of Member States to manage biological invasions. It has identified key actions to prevent, eradicate and control IAS of Union concern. However, putting these management recommendations into practice has not been without challenges. Limited resources and the absence of appropriate legal frameworks across Europe make the management of IAS difficult [1,2]. Moreover, the uncertainty associated with future developments of societies and environmental changes further challenges such management.

Previous studies predicted that by 2050 the numbers of alien species in Europe will increase by up-to 64% for most taxonomic groups [3]. These estimates are based on the assumption that past trends of alien species accumulation will remain unchanged. Such projections provide a baseline for understanding how biological invasions might develop in the future. However, the actual number and impacts of IAS depend on various environmental and socio-economic factors that are likely to evolve differently in the future.

Qualitative scenarios offer the flexibility to explore different potential futures considering a broad range of socio-ecological factors. They are not predictions; rather, they are narratives descriptions or stories that portray what might happen in the future. Despite their widespread use, commonly employed future scenarios, like the Shared Socioeconomic Pathways developed by climate change researchers [4], frequently overlook crucial factors driving biological invasions. Neglecting these factors results in an underestimation of future biological invasions and, consequently, biased forecasts of biodiversity changes.

Photograph of *Lithobates catesbeianus* by K. Schulz, licenced under CC BY 2.0. Image cropped from the original photograph.

Future Scenarios of Biological Invasions in Europe

AlienScenarios and InvasiBES, two projects funded through the 2017-2018 Belmont Forum and BiodivERsA joint call (refer to the "About this policy brief" section for additional details), explored qualitative scenarios about the future of biological invasions (until 2050). Initially, they developed a set of alternative futures for biological invasions worldwide [5], which were subsequently adjusted to the European scale, resulting in a more refined set of scenarios incorporating specific trends for Europe [6]. Four scenarios are now available to explore different futures of biological invasions in Europe (Figure 1). The greatest advantages of these new scenarios compared to other available future scenarios are that: (i) they include key factors driving biological invasions (such as trade, environmental awareness, biosecurity, and technological development) in addition to other, more general socio-environmental factors, and (ii) they account for specific trends in these factors operating at the European scale. By doing so, we can better understand the impact of biological invasions and ensure the inclusion of key drivers of biodiversity loss in environmental policies.

Figure 1. Artistic illustrations of the four future scenarios for biological invasions in Europe. Illustrations created by Kris Tsenova (Paidia Consulting Ltd). Find more details in [6].

Big Tech Rules Europe.

This scenario assumes high distrust in governments, and big companies have strong influence on European policy. People are economically stressed, focused on urban life and with little interest in nature. There is an exponential increase in IAS and a decrease in coordinated management, mainly focused on economically damaging IAS.

Technological (Pseudo-)Panacea.

European nations in this scenario cooperate strongly, with fast technological advancement, large trade volumes and high biosecurity being the prime societal and policy objectives. European societies are highly urbanophile and concentrate in "Smart cities". Technologies for reducing the ecological footprint of various activities are available and implemented across Europe. The rate of IAS establishment and spread is low because of strong and diligent biosecurity measures, which are supported by technological advances in automated and remote data collection and standardised protocols

Green Local Governance.

There is an increasing valorisation of local cultures and participatory democracy, with regional governments acquiring greater influence. European society follows the degrowth paradigm, with less technological progress but locally-based production highly valued. People move from urban to rural areas. The rate of IAS introductions is reduced owing to isolation and reduced trade, but IAS management is less efficient due to low coordination and less efficient biosecurity measures.

Lost (in) Europe.

This is an isolationist scenario with reduced international cooperation in policy, trade and transport. Consequently, social inequalities increase and environmental issues are only tackled nationally, if at all, leading to higher pollution, climate change and biodiversity loss. IAS introductions are reduced compared to today (due to isolation and less trade), but they are also less effectively monitored, and IAS management is very limited.

Managing Biological Invasions

IAS management strategy

Regarding the management of biological invasions, AlienScenarios and InvasiBES used the qualitative scenarios to develop a management strategy for biological invasions in Europe that can be adapted to the uncertainties emerging of the aforementioned scenarios [7]. The strategy was built around the vision that: "by 2050, the harmful impacts of IAS in Europe (EU member states and non-EU states) are substantially reduced compared to today". This vision is in concordance with the Kunming-Montreal Global Biodiversity Framework, which includes a target (Target 6) to reduce the introduction and establishment of IAS and their impacts [8].

Figure 2. A visual summary of the management strategy for IAS in Europe, consisting of 19 goals grouped into four categories: Policy (abbreviated as P), Research (R), Public Awareness (A), and Biosecurity (B). The strategy can be found in Panel S2 of [7].

This management strategy considers a wide array of goals (19 in total) related to policy, research, public awareness and biosecurity (Figure 2). The inclusion of this variety of goals highlights the complexity of managing IAS and the importance of considering elements complementary to direct management actions (e.g. prevention, eradication, control) of IAS. Several of these goals build on already identified actions [9], but AlienScenarios and InvasiBES take them further by incorporating and extending existing knowledge into an overall framework to guide action on IAS under different futures to devise a long-term management strategy of IAS in Europe.

By analysing the relationship between the strategy's goals, researchers found high connectivity among the goals of the management strategy. This highlights the integrative nature of the strategy and the mutual dependency of its components to ensure its effectiveness. Based on the most interconnected goals and most relevant cross-cutting aspects emerging from the management strategy, AlienScenarios and InvasiBES identified four main recommendations for managing IAS in Europe (see Box 1).

While none of these recommendations alone will be sufficient, they represent key elements for implementing a long-term strategy to manage biological invasions in Europe. [7].

Recommendation 1
European cooperation for a common and effective biosecurity regime

Establishing a dedicated European agency or an intergovernmental agreement furnished with a mandate and resources to regulate and oversee activities related to the management of IAS in Europe (beyond the European Union) will strengthen cooperation between states and stakeholders across the continent. It should foster interactions and synergies across sectors, stakeholders and biosecurity regimes, consider regional particularities (e.g. regarding differences in management priorities), and integrate local knowledge and cultures. Shared governance and participatory decision-making shall strengthen the legitimacy of agreed actions.

Recommendation 2
Cross-sectoral communication and outreach strategy

Establishing a cross-sectoral communication strategy about biological invasions (including a dedicated education curriculum for schools) and a centralized, multilingual communication platform at the European level will increase awareness of the causes and impacts of IAS and their management, as well as facilitate knowledge transfer and collaboration. Goals in all categories of the management strategy benefit from principles of good and transparent communication, leading to an increased understanding among stakeholders and the general public, which is required for sustained support of management actions.

Recommendation 3
Data standardization and management tools

Regularly identifying and addressing critical gaps in tools for impact/risk assessment and management of IAS will improve proactive and reactive capacity to manage (new) invaders. This includes creating and/or improving standard protocols for assessing introduction pathways, impacts, and vulnerability of priority areas, conceiving adaptive approaches to guide management decisions, and developing novel management techniques. These tools should be adopted at the country and European level, and if feasible, at the global level as well. Establishing a European centralised open data portal should facilitate the recording, storing, standardisation, updating, peer-reviewing, and accessibility of all information related to IAS management in Europe.

Recommendation 4
Monitoring, assessment and management priorities

Establishing a comprehensive regime for monitoring and assessing IAS at the European and country levels will improve the capacity for early detection and rapid response. Sound and comprehensive knowledge of the past, current and future circumstances of the introduction, establishment, and spread of IAS, as well as their (actual and potential) impacts and the success of past management attempts, is a prerequisite for effective management and for establishing management priorities.

Box 1. General fundamental principles that lie at the core of the management strategy and should lead to its implementation. More details in [7].

Strategy's feasibility

The feasibility of the management strategy differed when evaluated under the lenses of different possible futures (Figure 3). AlienScenarios and InvasiBES found that the management of biological invasions was less challenging in scenarios with a high level of technological development, public environmental awareness, and effectiveness of IAS policies. They also proposed solutions to improve the feasibility of the management strategy and its goals. Even though these solutions are likely still not sufficient to fully achieve the strategy's vision, their inclusion is an essential step to deliver a long-term strategy that is better prepared for future developments.

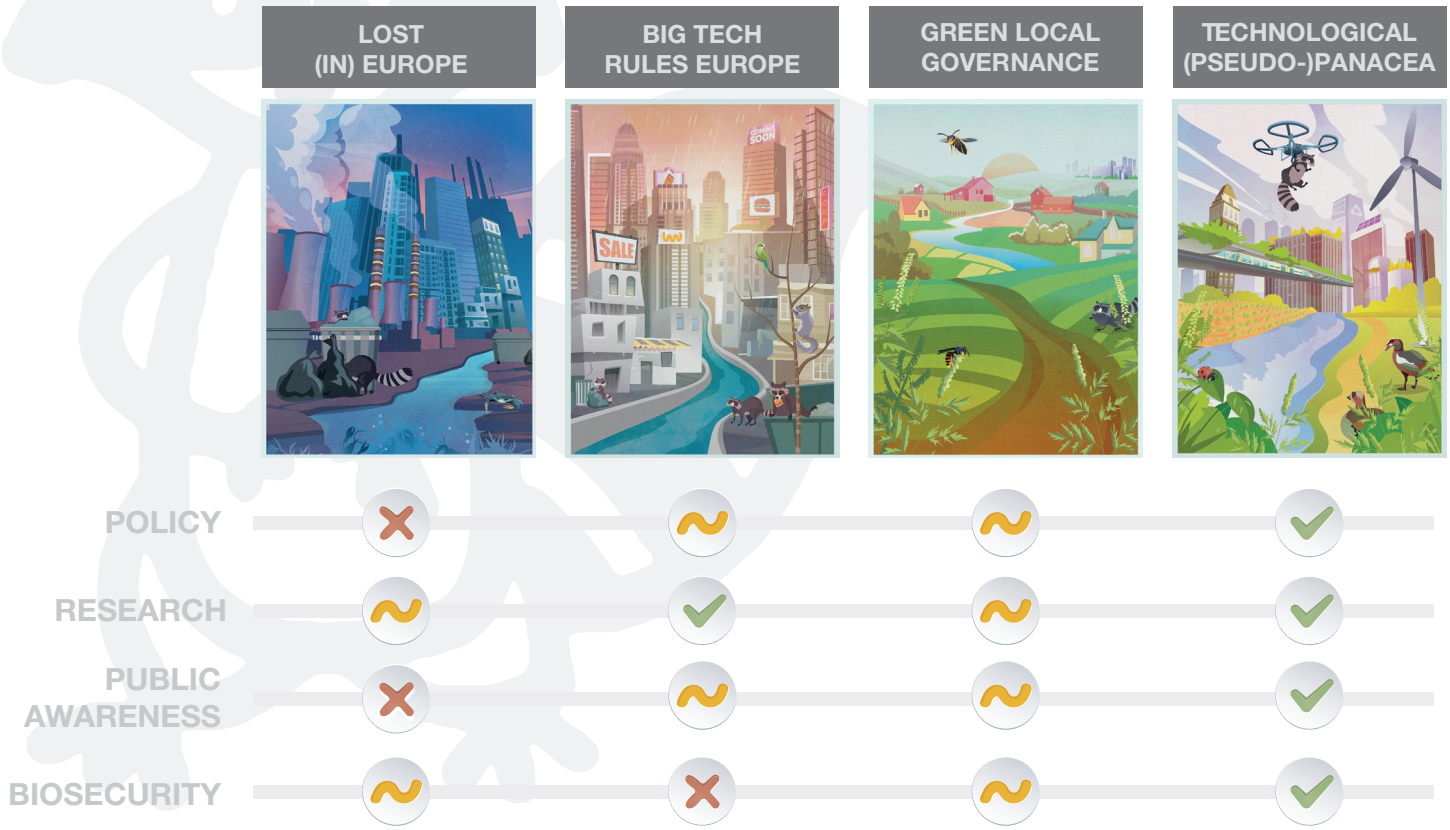

Figure 3. Feasibility of the management strategy's goals grouped by categories (i.e. Policy, Research, Public awareness and Biosecurity) in each scenario as judged by AlienScenarios and InvasiBES participants. Find more details in [7].

Photograph of *Zelus renardii* by N. Vicens (2023)

Conclusions

The qualitative **scenarios for biological invasions** developed in AlienScenarios and InvasiBES are expected to significantly contribute to:

1. Developing quantitative scenarios

These scenarios provide a narrative context for understanding the future of biological invasions and highlight important factors that can influence this future. They can assist scenario developers in creating more realistic and coherent quantitative models (e.g. see [10]).

2. Informing long-term management

Scenarios provide a long-term perspective and identify potential challenges and opportunities that may arise in different futures. This allows to develop management strategies that are adaptable to a range of possible futures and are thus suited to uncertain and changing environments.

3. Raising public awareness

Scenario descriptions and illustrations allow to imagine various ways in which biological invasions might unfold, fostering a clearer understanding of the problem and inspiring proactive actions. Please see the video AlienScenarios – Scenarios of biological invasions for the 21st century (https://www.youtube.com/watch?v=TuvFWfncvvU).

The **management strategy for biological invasions** developed in AlienScenarios and InvasiBES is expected to assist decision making by:

1. Providing a guiding framework

The management strategy establishes a comprehensive guiding framework for addressing the management of biological invasions in Europe. This overarching strategy should be complemented by specific management strategies tailored to individual species and/or certain regions.

2. Identifying key recommendations

The analysis of the management strategy allowed to identify four key recommendations that should guide the foundation of a long-term strategy for managing biological invasions in Europe [7].

It is time to shift the focus of biological invasion management toward a more integrated perspective that takes into account different sectors and countries, and explicitly accounts for plausible future scenarios.

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About this policy brief:

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Citation:

Roura-Pascual N, Saul W-C, Pérez-Granados C, Rutting L, Peterson GD, Latombe G, Essl F, Adriaens T, Aldridge DC, Bacher S, Bernardo-Madrid R, Brotons L, Diaz F, Gallardo B, Genovesi P, Golivets M, González-Moreno P, Hall M, Kutleša P, Lenzner B, Liu C, Pagitz K, Pastor T, Rabitsch W, Robertson P, Roy HE, Seebens H, Solarz W, Starfinger U, Tanner R, Vilà M, Leung B, Garcia-Lozano C, Jeschke JM. 2024. The future management of biological invasions in Europe. AlienScenarios and InvasiBES policy brief. Zenodo. https://doi.org/10.5281/zenodo.10873244