

# Developing and applying scenarios of biological invasions for the 21st century (AlienScenarios)



## Description of the project

### A. Detailed description of the research area and research plan

#### **Research questions, scientific objectives and novelty**

Human agency has modified virtually every facet of the biophysical environment (Lewis & Maslin 2015) with profound implications for the status, distribution and resilience of biodiversity worldwide (Leadley et al. 2010). Several major drivers of biodiversity loss have been identified with climate change, land-use change and biological invasions being among the most important ones (CBD 2014). Changes in climate and land use have received much attention during the last decades, which resulted in readily available scenarios (Lamarque et al. 2005, Hurtt et al. 2011, Moss et al. 2010, IPCC 2013, Popp et al. 2016). In contrast, comparable approaches are completely missing for biological invasions despite its importance in driving biodiversity losses (Simberloff et al. 2013, Blackburn et al. 2014), and causing substantial negative impacts on human livelihoods (Pejchar & Mooney 2009). Worryingly, recent research has shown that numbers of alien species are rising unabatedly in most taxonomic groups (Seebens et al. 2017, 2018). Therefore, **a thorough evaluation of plausible future trajectories of biological invasions is urgently needed to enable comprehensive assessments of biodiversity changes for the decades to come**, and to allow better-informed decisions of policy makers and stakeholders (Ferrier et al. 2016), and to examine the future implications of different societal responses for biological invasions.

In **AlienScenarios**, we will close this gap by, for the first time, evaluating the range of plausible futures of biological invasions for the 21<sup>st</sup> century at different spatial scales and for a range of taxonomic groups. We will use complementary data and approaches, and examine multiple measures of impacts. We will combine the strategic forward-looking methodology of scenario planning with advanced modelling approaches to **construct plausible global mid-term (2050) and long-term (2100) futures of biological invasions and their impacts** taking into account uncertainties. In this context, we will take advantage of several recently compiled large data sets of global alien species distributions, which have partly been compiled by members of the project team, and to which the project team has access to: vascular plants (GloNAF, van Kleunen et al. 2015, Pyšek et al. 2017), amphibians and reptiles (Capinha et al. 2017), mammals (Dawson et al. 2017), birds (GAVIA, Dyer et al. 2017) freshwater fish (Dawson et al. 2017) and selected invertebrates (ants, spiders, Bertelsmeier et al. 2013, Roura-Pascual et al. 2016, Dawson et al. 2017). In addition, we will use the Alien Species First Record Database (Seebens et al. 2017, 2018), an exhaustive database of global historic alien species accumulation rates. Finally, for regional analyses we will use complementary alien species data for in depth-analyses.

#### **Objectives**

Based on the above-mentioned approaches and data sources, we will address the following key research challenges:

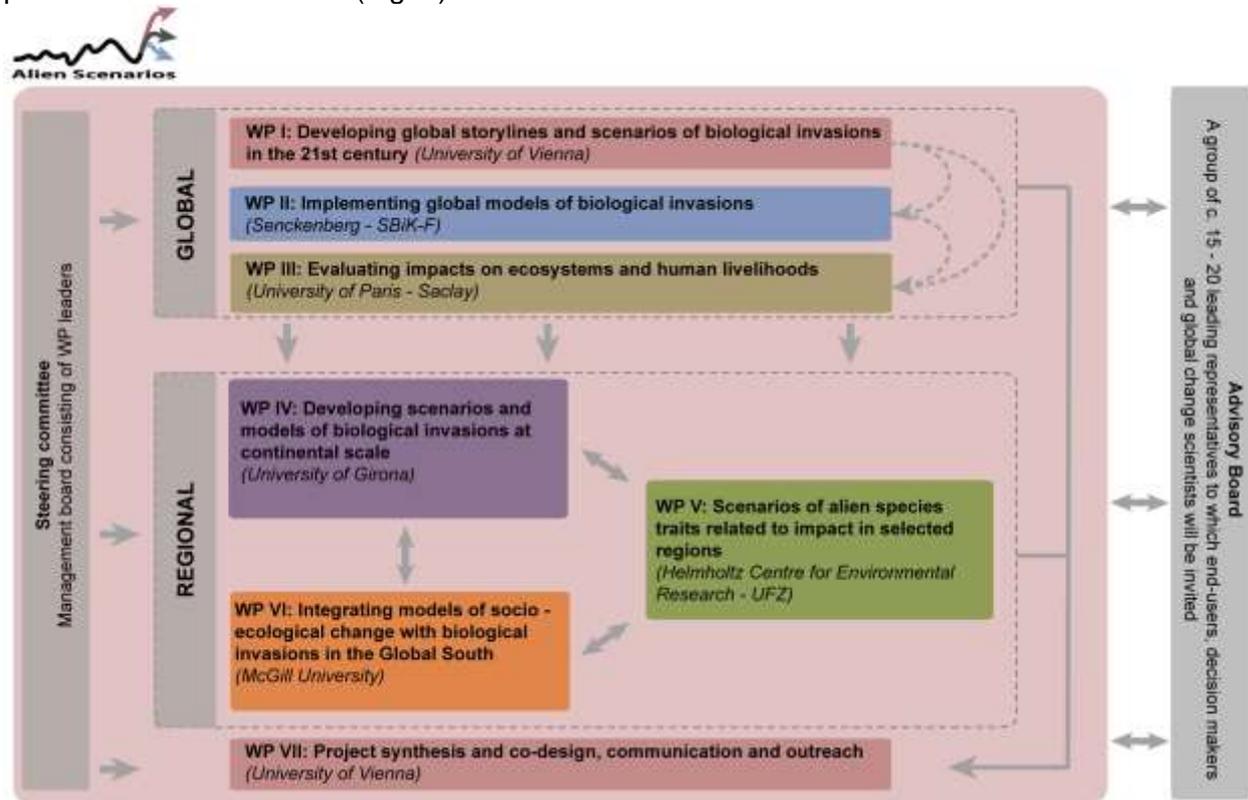
- 1) Developing the **first global scenarios for biological invasions** for the 21<sup>st</sup> century
- 2) Implementing **global quantitative models** of future alien species numbers under different biological invasion scenarios
- 3) Evaluating the **future impacts of biological invasions** on the environment and human livelihoods under different scenarios at a global scale
- 4) Establishing **continental (Europe) scenarios and models** of biological

- invasions to assess the effectiveness of the EU regulation of invasive alien species
- 5) Assessing the relationships of **alien species traits** related to future impacts of biological invasions
  - 6) Expanding beyond temperate developed regions to understudied but highly biodiverse regions, and considering **invasions in the context of the Global South**
  - 7) Analysing the consequences of biological invasions in the 21<sup>st</sup> century under different **scenarios for policy, alien species management and science.**

Each of these challenges will be addressed in a separate WP. In summary, in AlienScenarios we will quantitatively elucidate the plausible range of future invasion trajectories, provide crucially needed data for pro-active alien species management and policy, and explore options for arriving at preferred futures through the adaptation of existing policies.

### Work plan and division of work packages

**AlienScenarios consists of seven integrated work packages** that are led by six partners of the consortium (Fig. 1).



**Fig. 1: Project management structure and the interactions between the work packages of AlienScenarios.** Shown are the seven work packages (WP), the institution of the WP lead, the integration of the WP within the project, the external Advisory Board, and the Steering Committee consisting of the WP leaders that is responsible for internal decision making. The arrows indicate the interconnectedness of the WP in terms of data, idea and material exchange.

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