Developing and applying scenarios of biological invasions for the 21st century
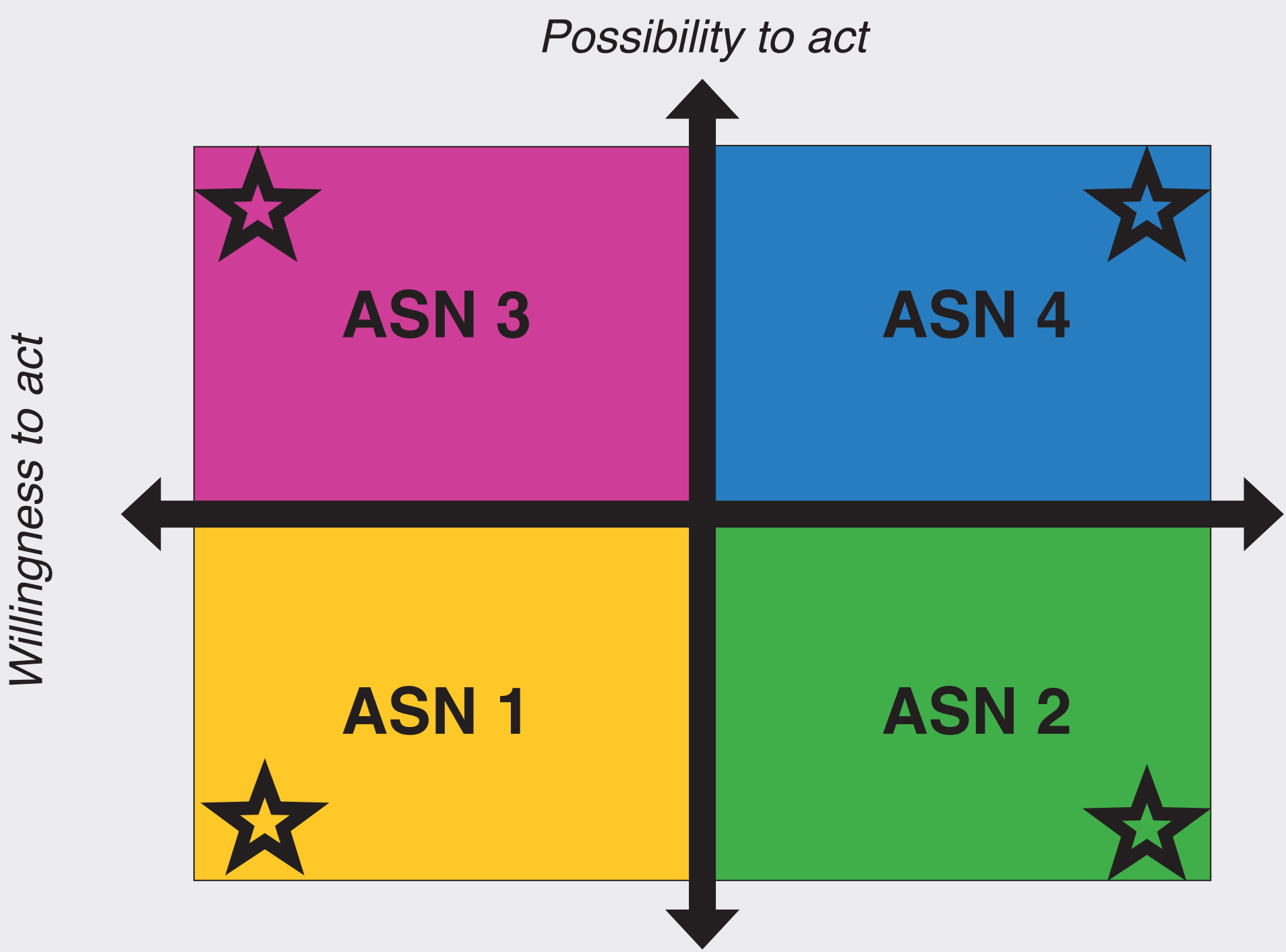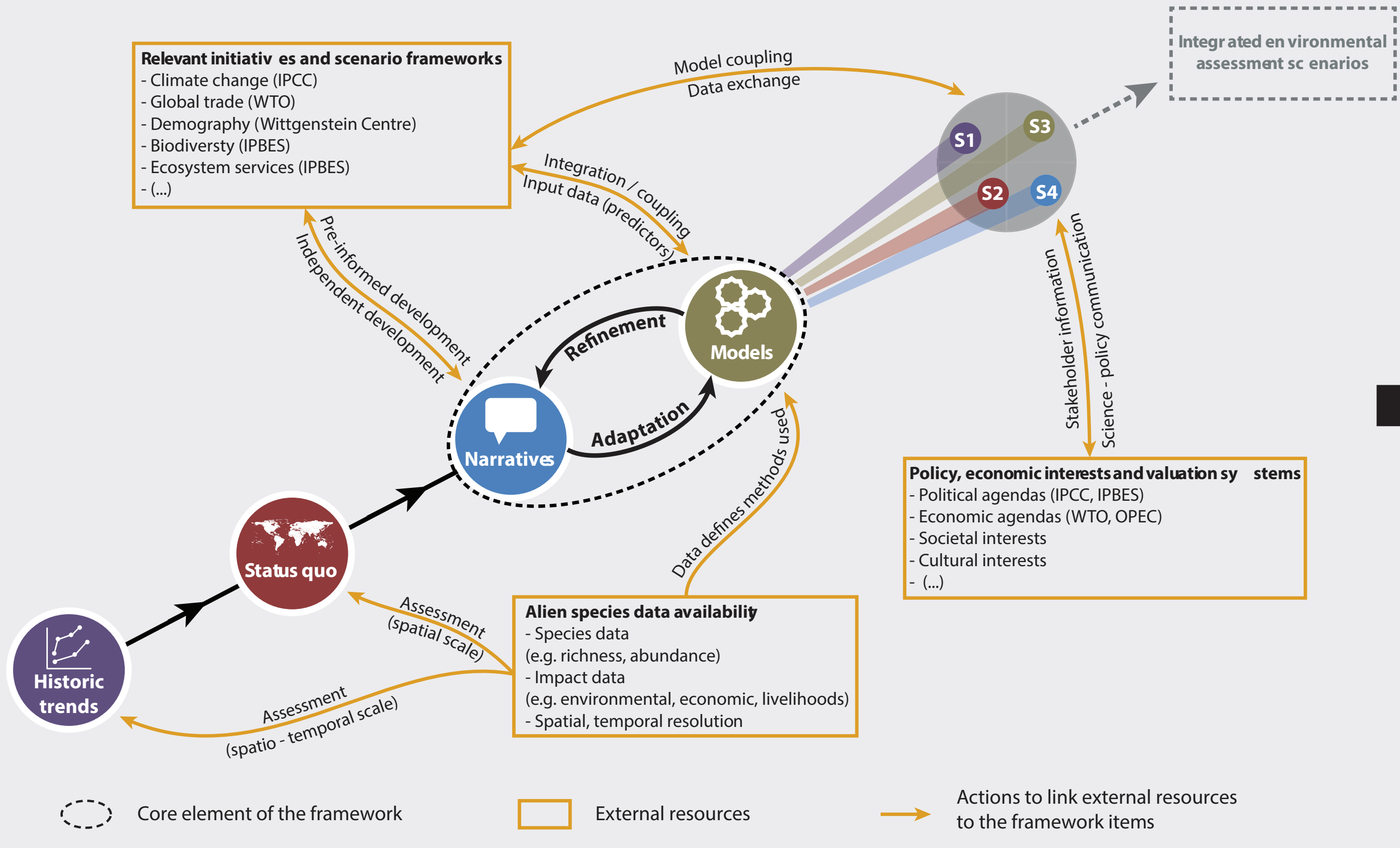
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Alien Scenarios

🌐 alien-scenarios.org

First global scenarios for the 21st century

The key elements and key steps for developing a **framework for scenarios and models of biological invasions**. The figure is composed of a conceptual layer (circles) that describe the **stepwise scenario development process** from initial data assessment and mobilization to **storyline construction**, **model quantification**, and, finally, to **full scenarios of biological invasions**. The grey circle (top right) resembles the potential option space of biological invasions in the future and the explored space by four exemplary individual alien species scenarios (S1–S4). The boxes depict components that influence the development process or that might be influenced by it. The arrows between the conceptual and influencing properties indicate strong interactions. The grey dashed arrow and box represent the potential long-term aim of fully **integrated environmental assessment scenarios including all relevant parts of the Earth's system**.

Lenzner B, Leclere D, Franklin O , Seebens H, Roura-Pascual N, Obersteiner M , Dullinger S, & Essl F (2019). A Framework for Global Twenty-First Century Scenarios and Models of Biological Invasions. BioScience. DOI:10.1093/biosci/biz070.

Four broad Alien Scenario Narratives (ASN) can be defined according to two axes: willingness to act and possibility to act. From these four narratives, four extreme global scenarios ☆ can be explored.

- Global quantitative models of future alien species numbers
- Future economic cost of biological invasion
- Effectiveness of EU regulation
- Alien species traits and future impacts
- Biological invasions in the global South

→ Policies, management and science

Drivers toolbox

Selection of highly important drivers of future biological invasions and associated variables
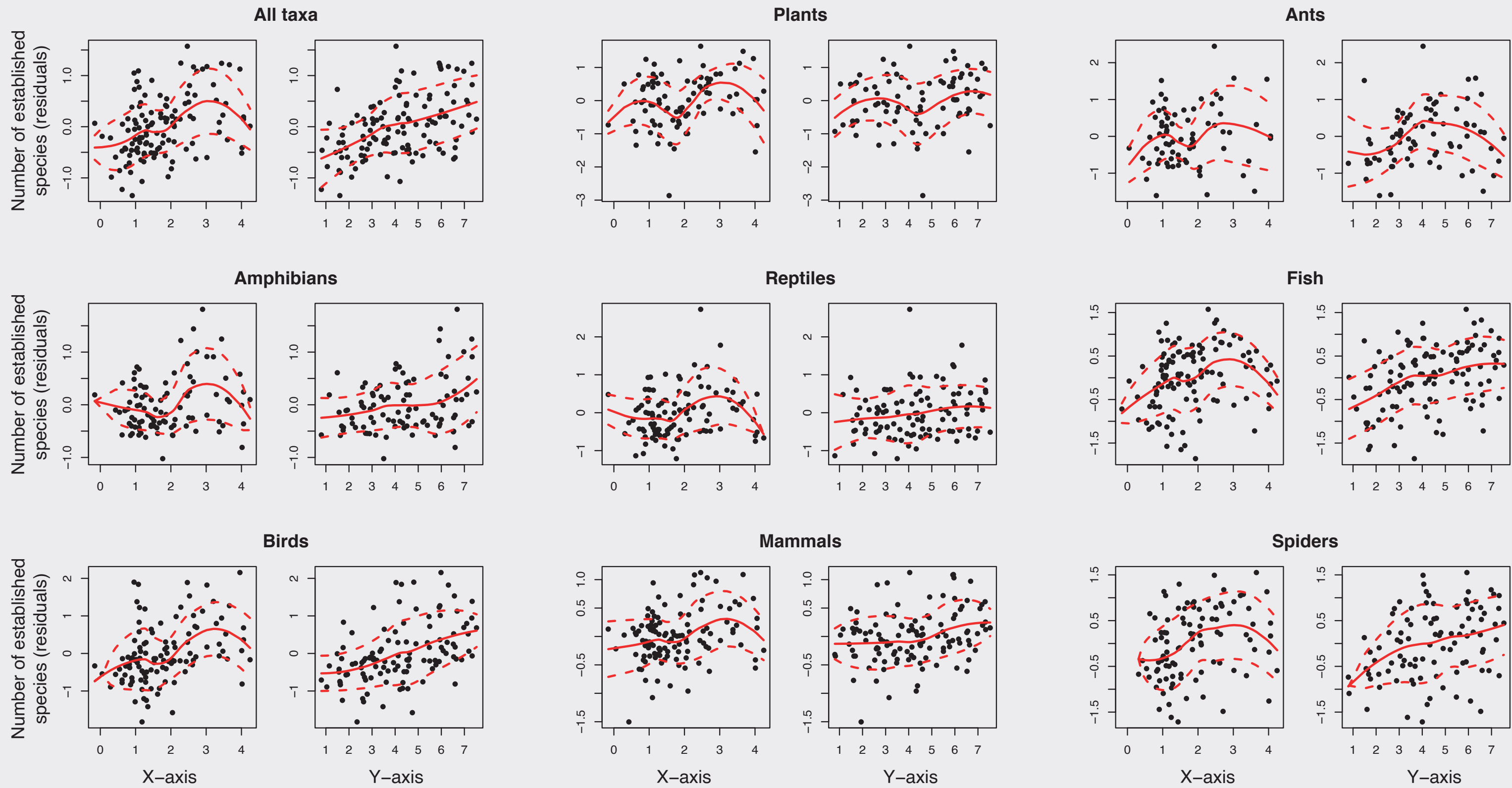
Latombe et al (in prep.)

DRIVER CATEGORY	DRIVERS General concepts important for IAS	RATIONALE OF THE DRIVER FOR IAS	VARIABLES Various ways to quantify the corresponding driver
POLITICS AND DEMOGRAPHICS	International politics, governance and legislation	Global political context has no direct causal impact on invasions, but strongly underlies (directly or indirectly) most other direct drivers.	Voice and Accountability / Control of Corruption / Political Globalisation Index
	Social and political stability	By being moving or displaced from one country to another, people transport IAS with them. The more people, the more movements and the more stoaways.	Political Stability and Absence of Violence / Interpersonal Globalisation Index / Population size
ECONOMY AND TRADE	Economic growth	Socio-economic activities are correlated with a wide range of changes of the environment (e.g. resource and energy uses, human mobility, land use) that may be relevant for facilitating biological invasions.	GDP per capita / GNI per capita
	Global trade	Trade is the main cause of IAS are introductions outside of their native range.	Trade Globalisation Index
ENVIRONMENTAL AND NATURAL RESOURCES	Land use change	Changes in land-use (incl. the intentional use of IAS) and land-use intensity may cause losses of ecosystems, degradation of used ecosystems, increase fragmentation and disturbance of ecosystems, and alter resource dynamics; all these are factors that may favour biological invasions and reduce biotic resistance.	Human appropriation of net primary production / Global human influence index
LIFESTYLE AND VALUES	Lifetstyle and values	The awareness and values of the citizens, stakeholders, business, NGOs and politicians towards biological invasions is important for establishing and implementing IAS policies and management. Includes also the views of people who are opposing actions on IAS on ethical grounds (e.g. animal-right movements; cute IAS species are likely less managed because they generate empathy) or because they consider it unwarranted.	Educational attainment distribution / Renewable electricity output / Cultural Globalisation Index / Information Globalisation Index
SCIENCE AND TECHNOLOGY	Technology and innovation	Technological advancements enable to actively implement biocontrol and management measures. They can also favour other drivers such as pressure on natural resources and land use, which can favour biological invasions	Global Innovation Index
SOCIETAL RESPONSE	Legislation and management	Legislation and the resulting management actions are necessary to prevent the transport, introduction, establishment and spread of IAS	Governmnent effectiveness / Regulatory Quality / Rule of Law

Cross-country narratives and relationship with number of established alien species
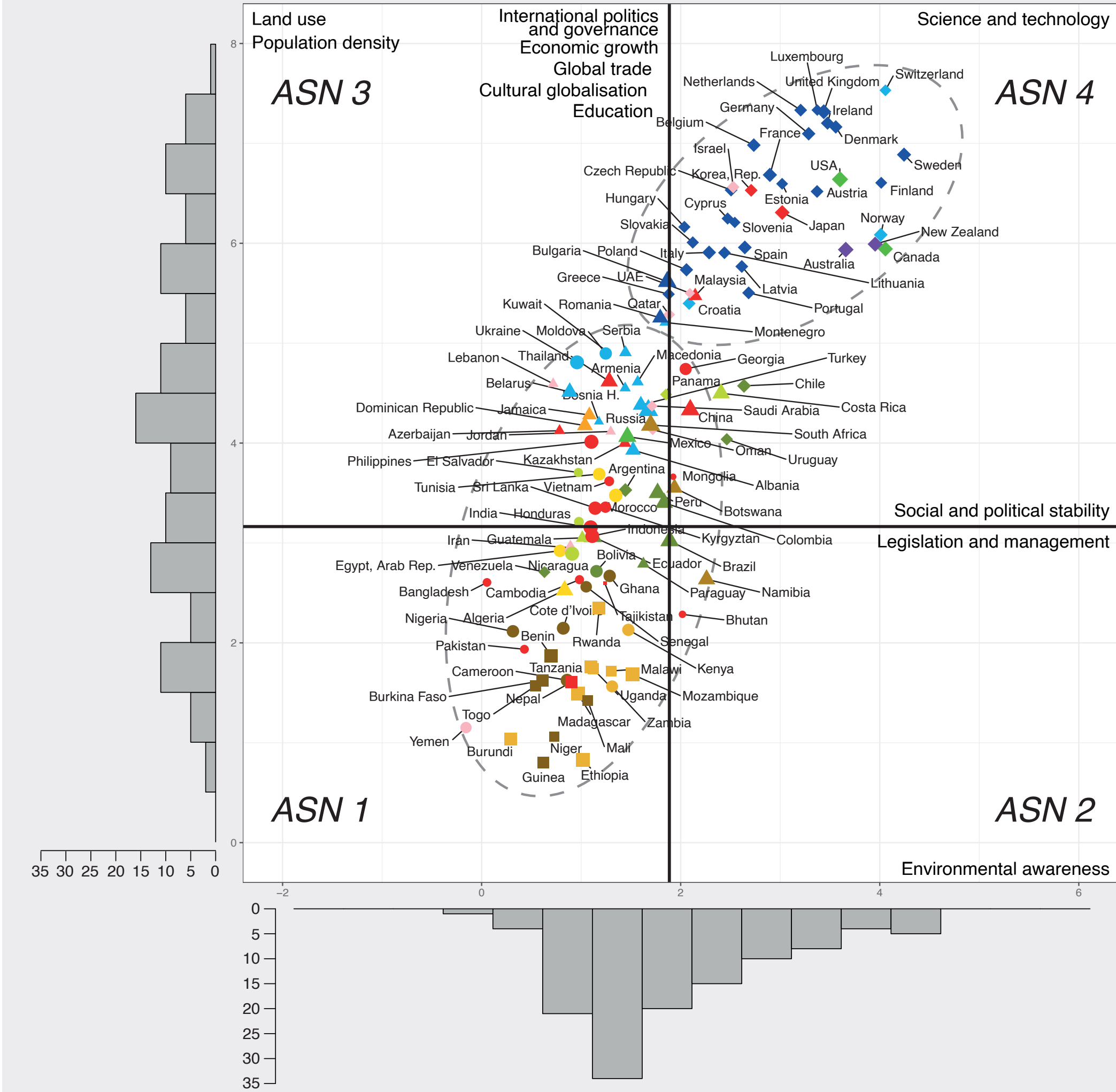
122 countries organized in a two-dimensional space defined by drivers of biological invasions.

log(number of established species + 1)
- 4
- 6
- 8

GNI
- Low income
- Lower middle income
- Upper middle income
- High income

Region
- EU
- non EU
- Middle East
- Asia
- Northern Africa
- Eastern Africa
- Western Africa
- Southern Africa
- Oceania
- Northern America
- Central America
- Southern America
- Carribean

Relationships between the number of established species in a country (for different taxa) and its coordinates in the two-diemension space defined by drivers of biological invasions.

Latombe et al (in prep.)