Invasion pathways, species invasion success and habitat invasibility in Europe

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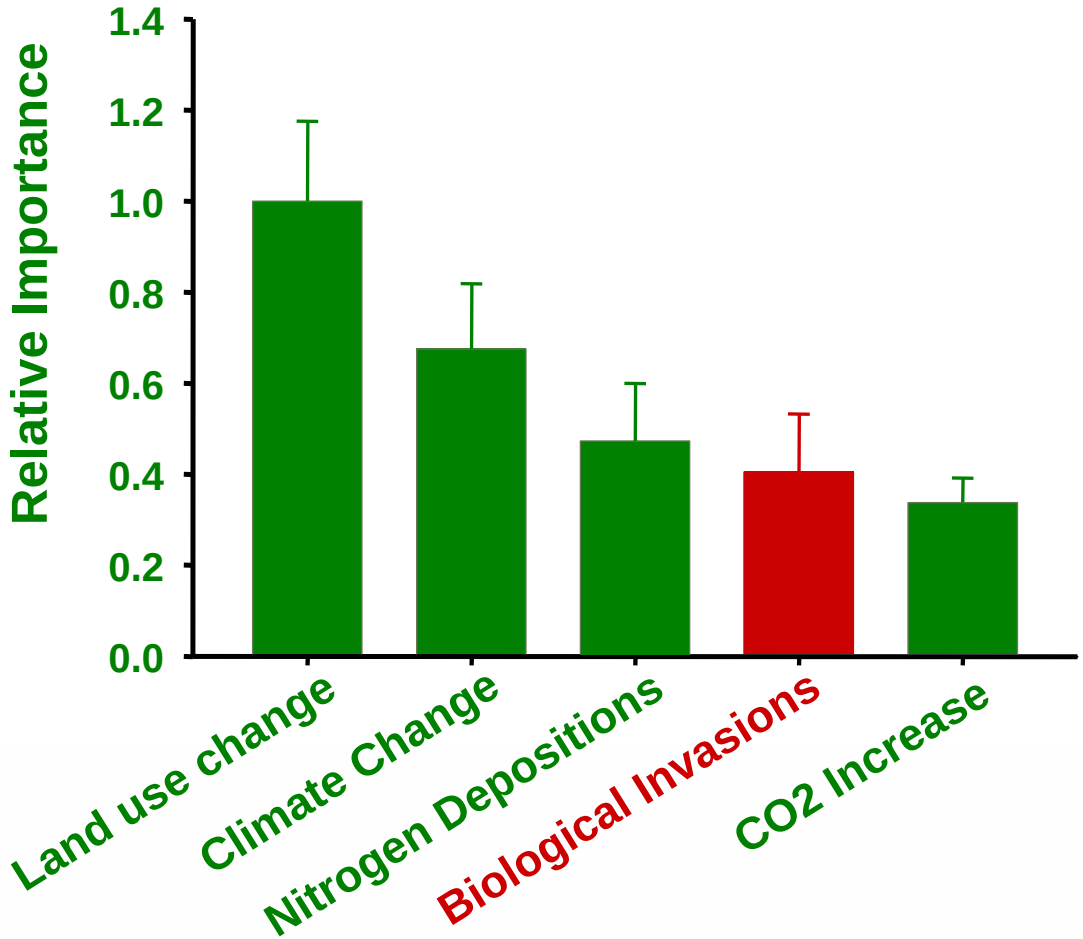
Biological Invasions and the Biodiversity Crisis



Sala et al. (2000): Science 287: 1770-1774

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Comparative analyses in invasion biology

- Invasiveness of species
  - Pathway of introduction
  - Species characteristics
  - Propagule pressure
  - Time of introduction
- Invasibility of ecosystems/habitats

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Problems with such comparative analyses

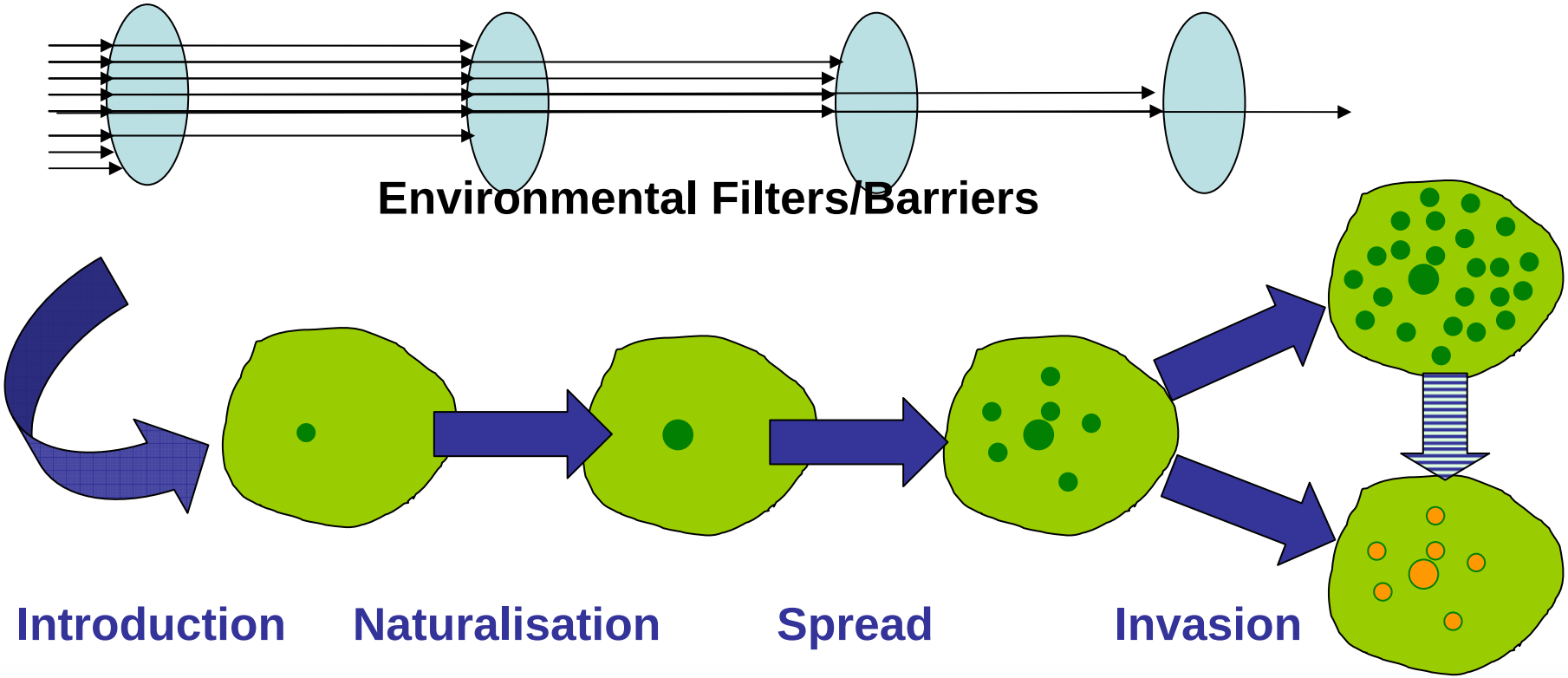
- Confounding invasibility with invader pools
- Confounding invasibility with propagule pressure
- Confounding invasibility with invasiveness
- Spatial non-independence of introduction events
- Phylogenetic non-independence of introduction events

Sol, Vilá & Kühn 2008, Biol. Invasions, 10:1119–1129

Invasiveness of species:

Pathway of introduction

Steps of the invasion process



See Richardson et al. 2000, Heger 2001, Rahel 2002, Colautti & MacIsaac 2004, Hulme 2004, Pyšek et al. 2004

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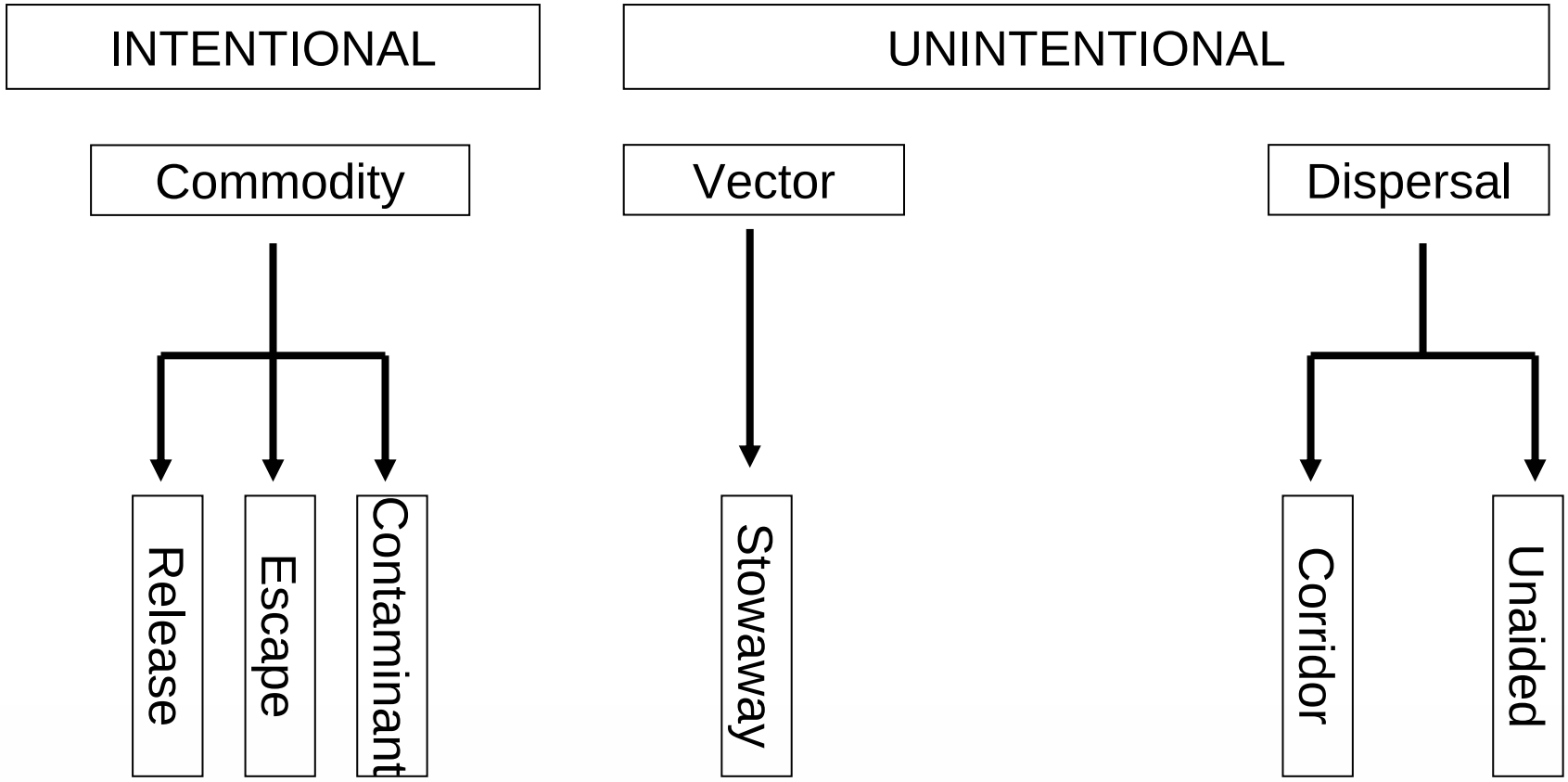
Pathways of Biological Invasions



Hulme et al. 2008, J. Appl. Ecol. 45: 403–414

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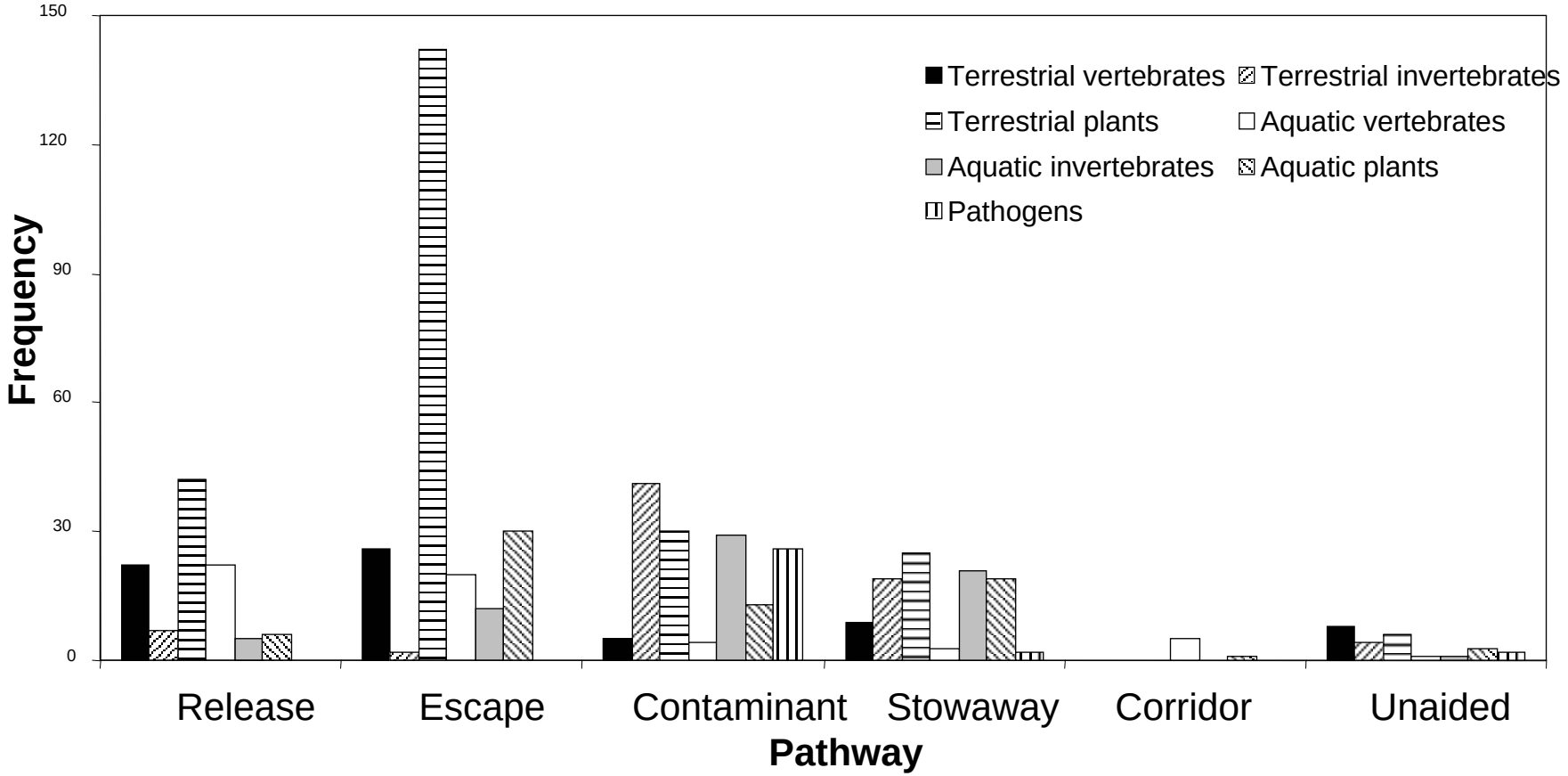
Frequency of pathways



Hulme et al. 2008, J. Appl. Ecol. 45: 403–414

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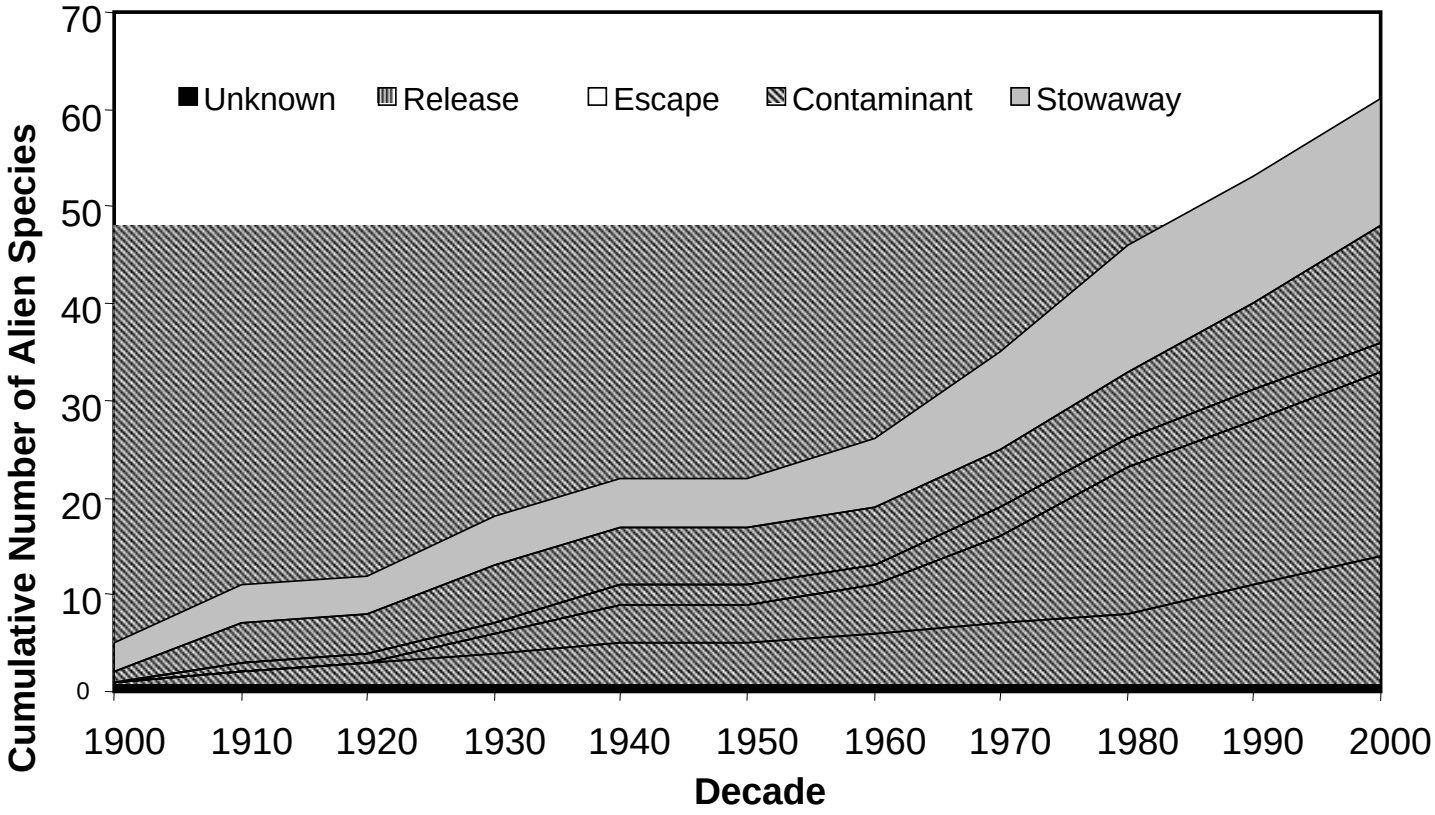
Temporal Trends of Marine Invaders



Hulme et al. 2008, J. Appl. Ecol. 45: 403–414; data from NOBANIS (North European and Baltic Network on Invasive Alien Species, http://www.nobanis.org/)

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Naturalisation rate of terrestrial alien species in Europe

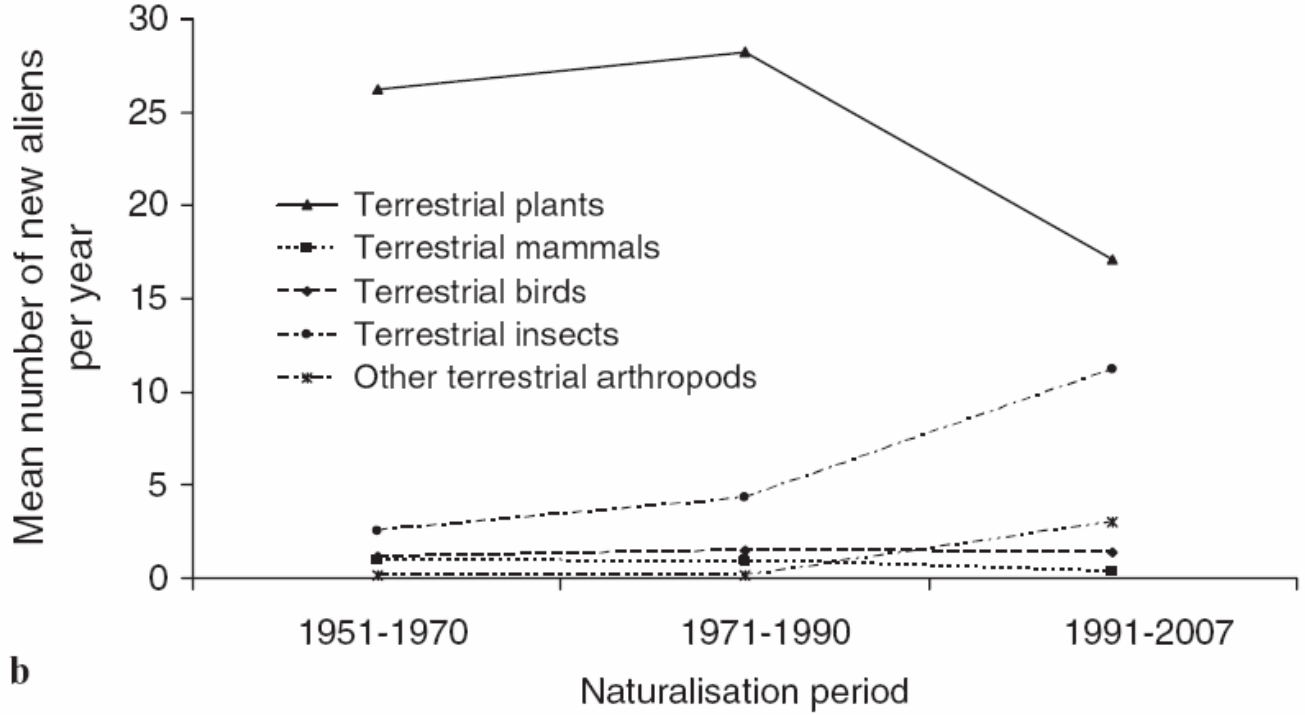

Fig. 1.3 Pan-European trends in the average number of new alien plants, invertebrate, fish, birds and mammals naturalising in Europe per year in three time periods 1951–1970; 1971–1990 and 1991–2007 in (a) aquatic and (b) terrestrial environments

DAISIE 2008, Handbook of Alien Species in Europe. Springer.

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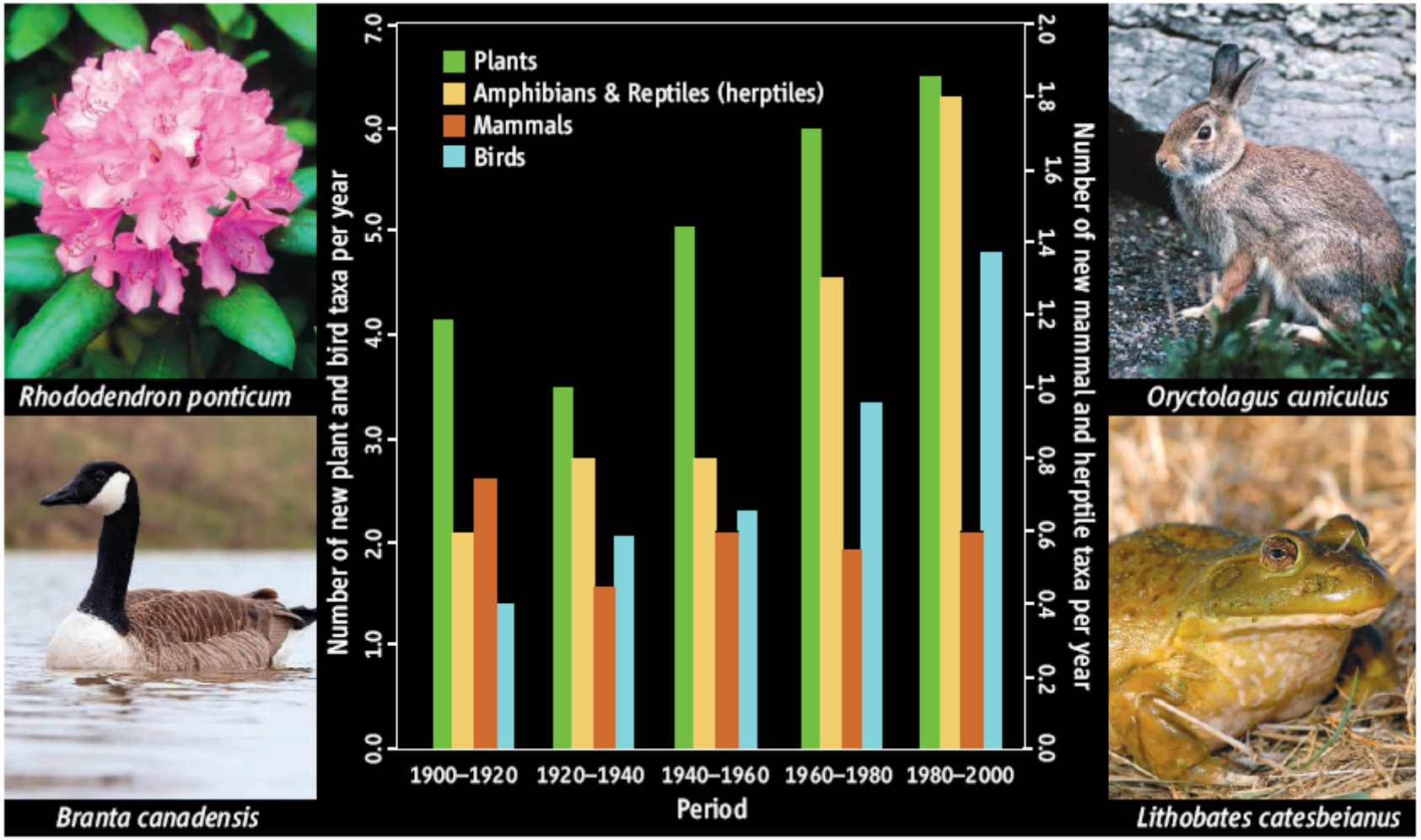
Numbers of established alien species in Europe



DAISIE 2008, Handbook of Alien Species in Europe. Springer.

Hulme et al., 2009, Science 324: 40-42

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Invasiveness of species:

Species characteristics

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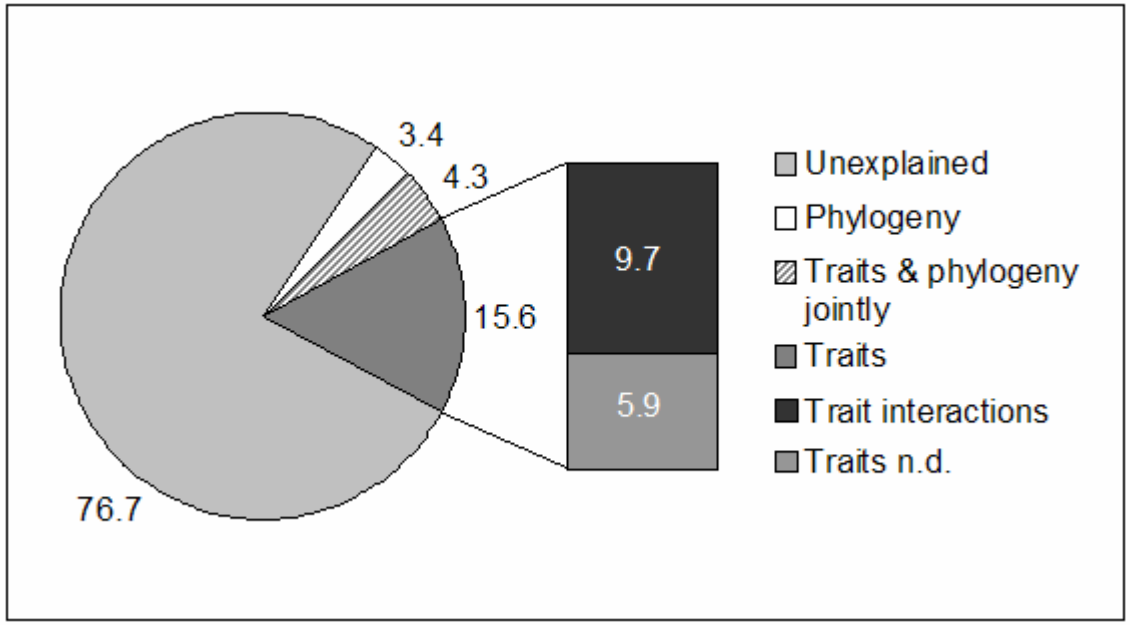
Trait interactions are important!



Küster, Kühn et al. 2008, J. Ecol. 96: 860-868

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Propagule pressure ?

explaining variable	Chi²	Df	p-value
hardiness	10.002	1	<0.001
growth form	24.204	2	<0.001
plant height	4.381	1	<0.05
number of continents	12.343	1	<0.001
number of gardens	193.682	1	<0.001
hardiness × growth form	8.346	2	<0.05
plant height × number of gardens	5.153	1	<0.05

Hanspach, Kühn et al. 2008, Persp. Plant Ecol. Evol. Syst 10: 241-250

Invasiveness of species:

Time of introduction

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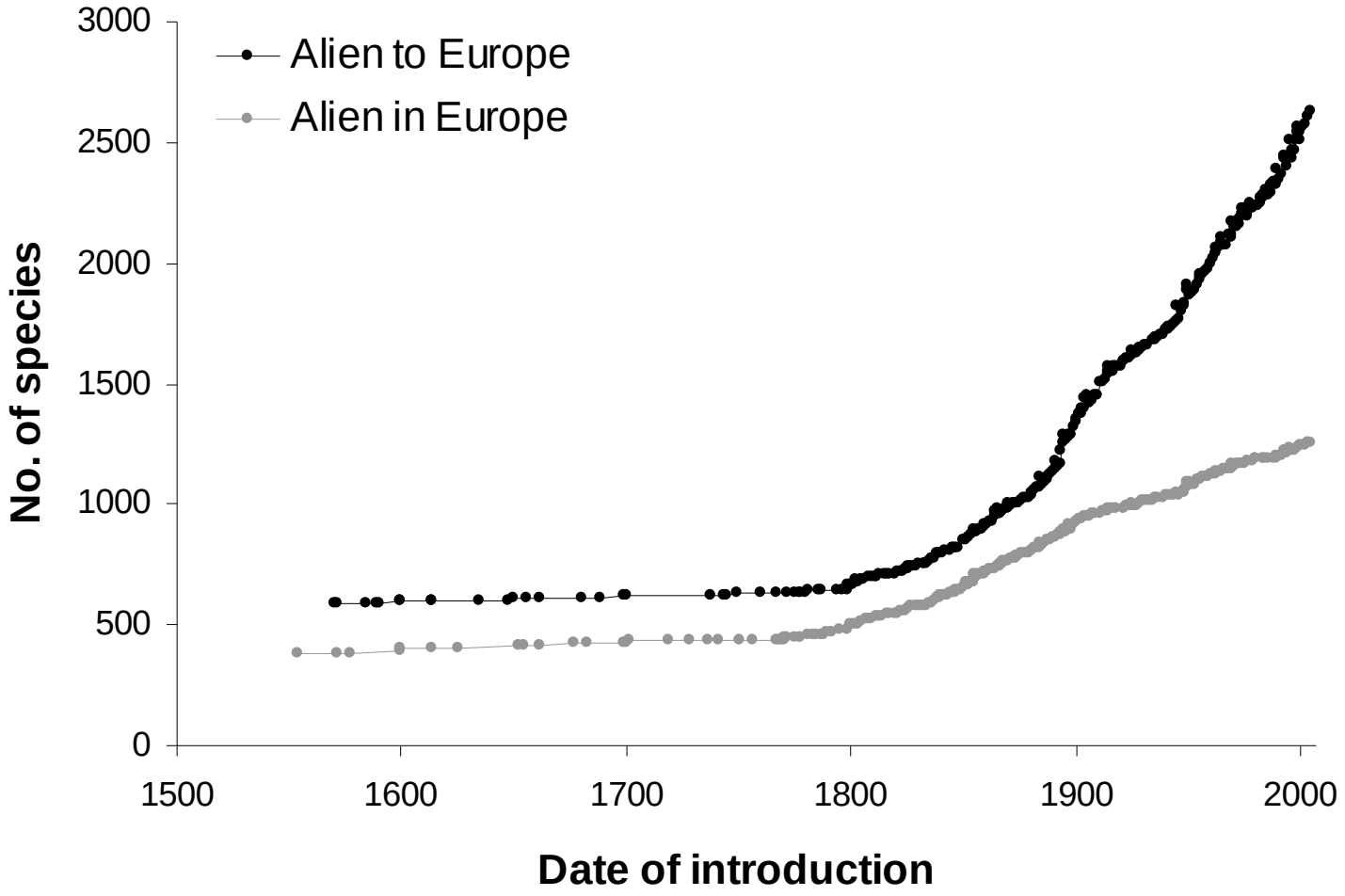
Temporal dynamics of invasions in Europe



Lambdon et al. 2008, Preslia 80: 101-149

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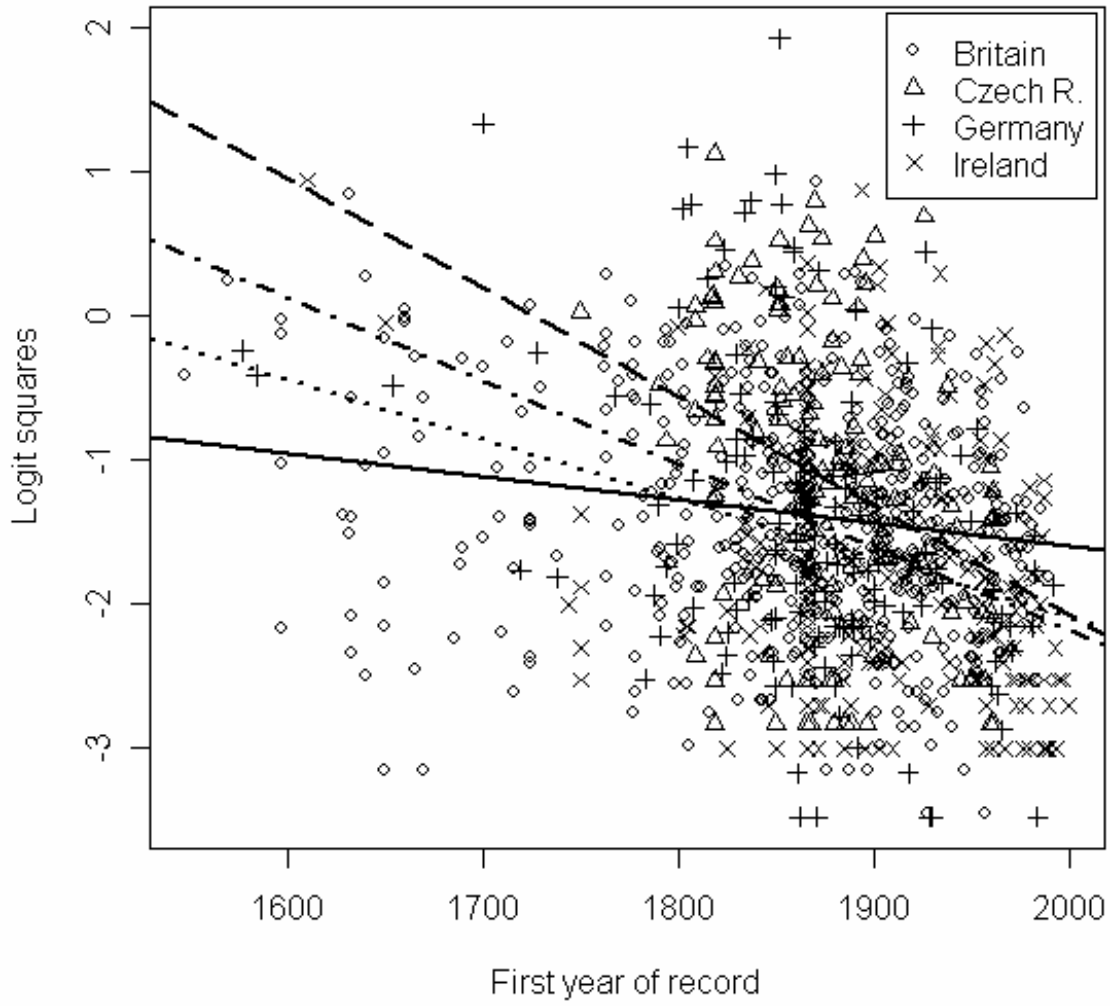
Time since introduction and invasion success



Williamson, Dehnen-Schmutz, Kühn et al. 2009, Diversity & Distributions 15: 158-166

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Time to full distribution (range filling)

	years until regression	s.e.	years until RMA	s.e.
Ireland	290	42.64	151	17.02
Britain	351	57.98	177	23.75
Germany	166	16.94	145	15.60
Czech Republic	160	14.02	141	12.26

Williamson, Dehnen-Schmutz, Kühn et al. 2009, Diversity & Distributions 15: 158-166

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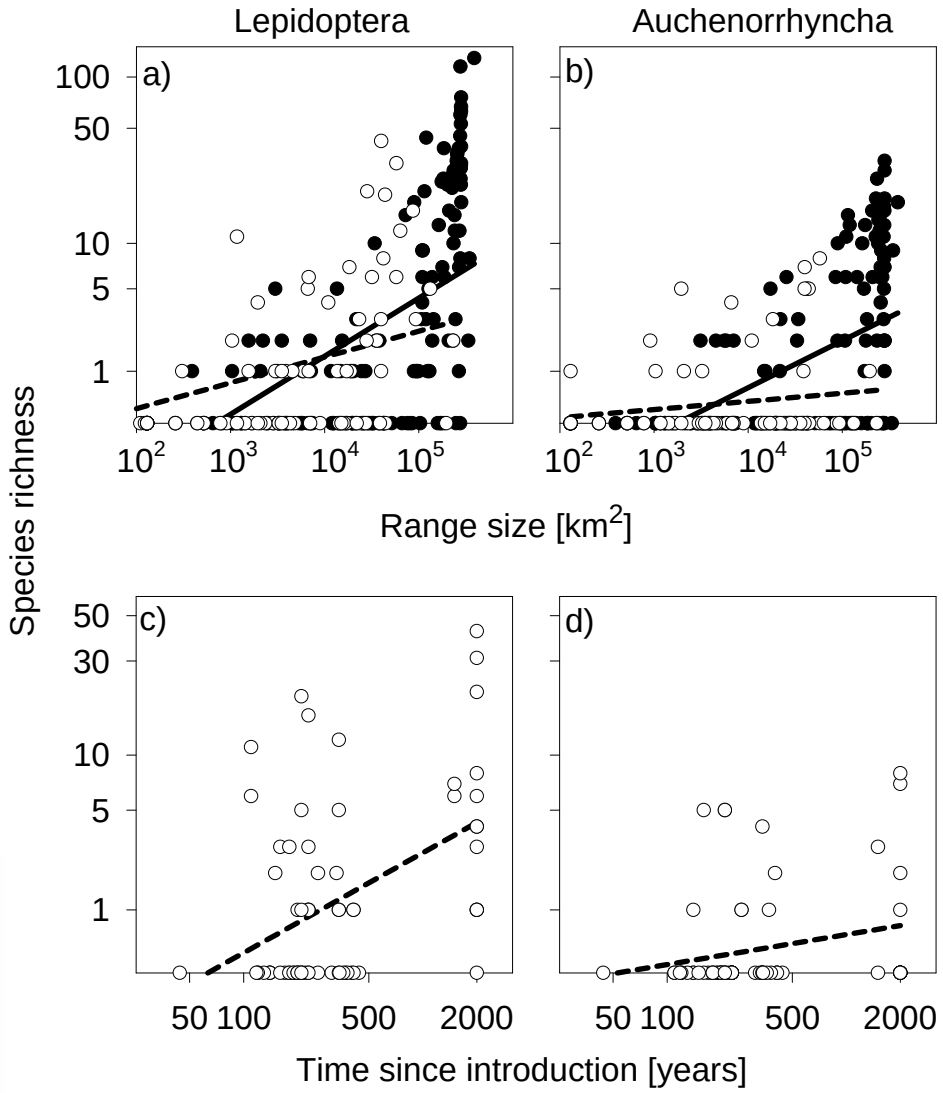
Invasions in herbivores



Brändle, Kühn et al. 2008, Diversity & Distributions 14: 905-912

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Invasibility of ecosystems/habitats

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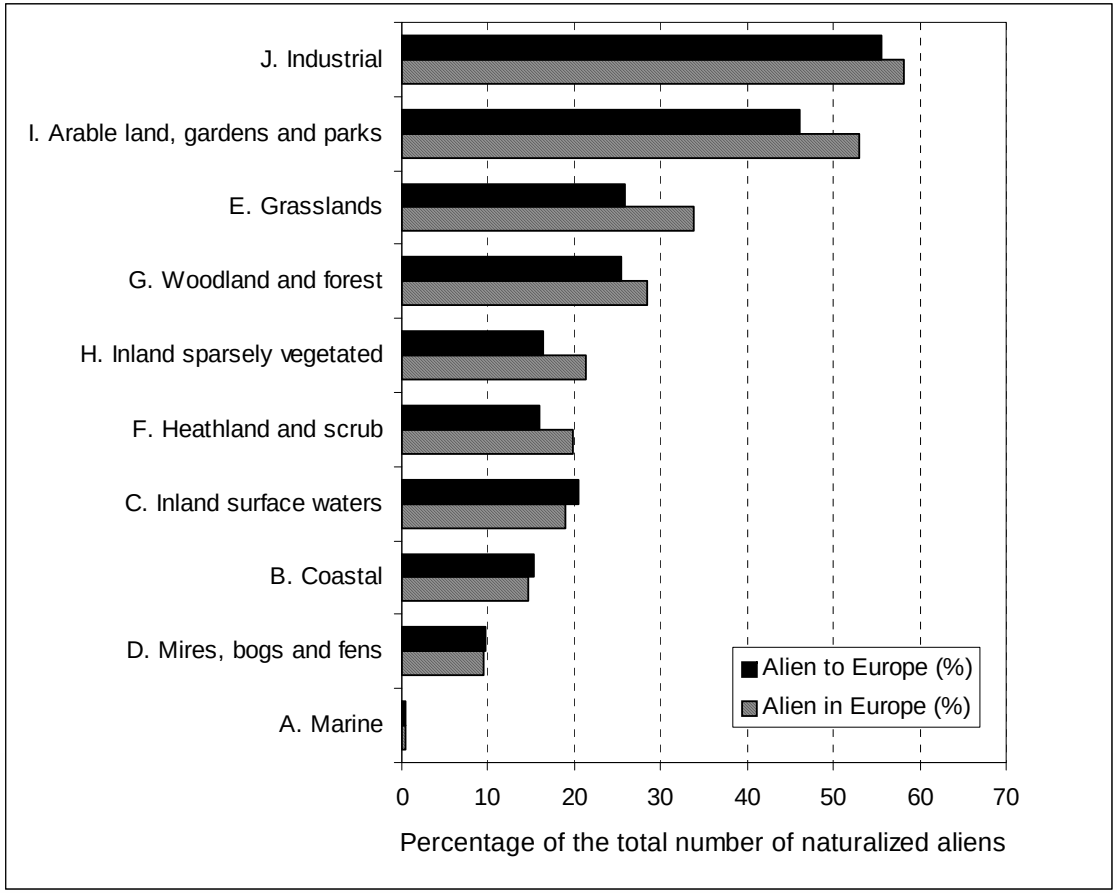
Distribution of European naturalized aliens in EUNIS habitats



Lambdon et al. 2008, Preslia 80: 101-149

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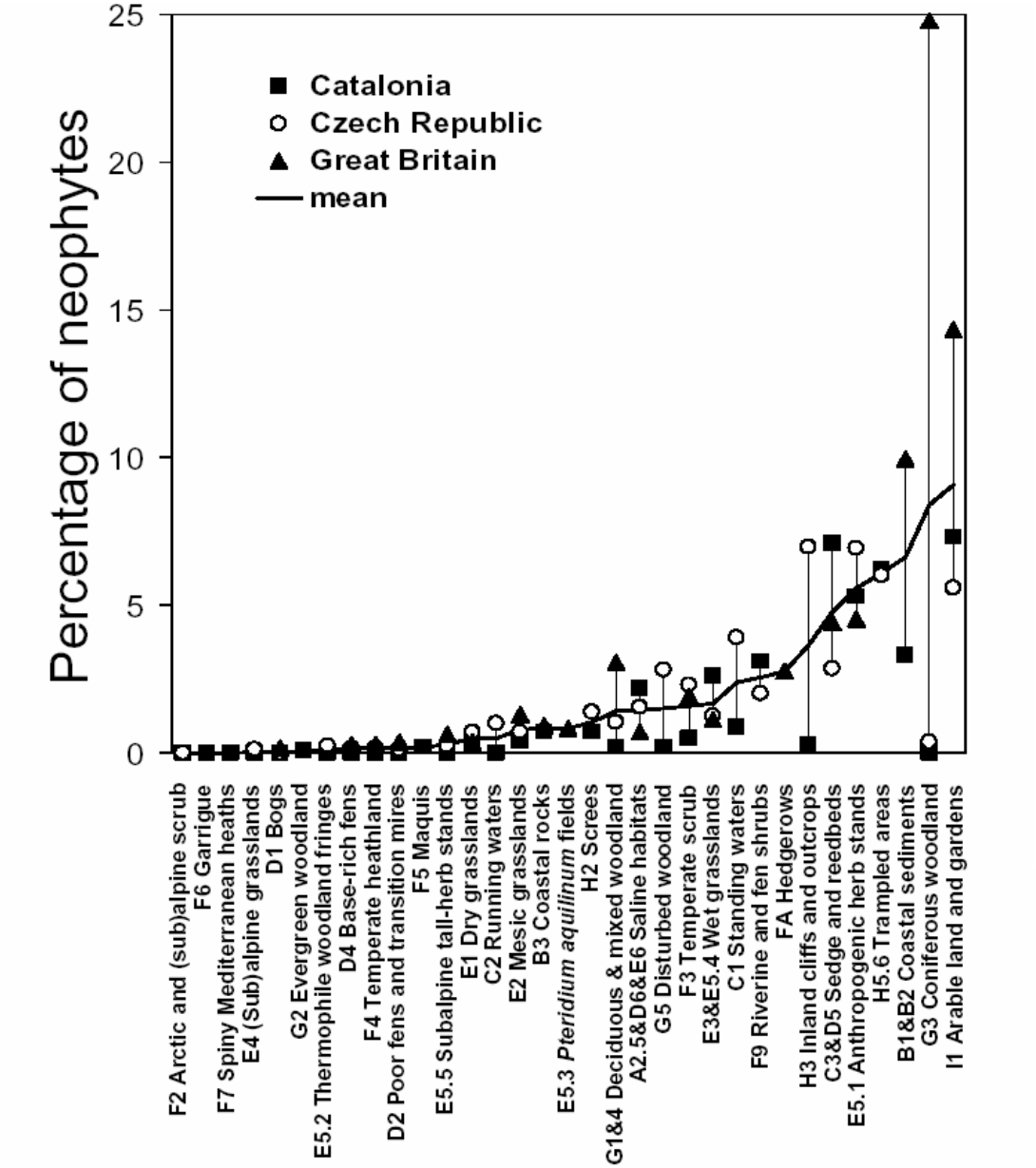

Percentages of neophytes occurring in vegetation plots in EUNIS habitats in Catalonia, Czech Republic and Great Britain. Habitats are ranked by increasing mean percentages.

Chytrý et al. 2008. Journal of Applied Ecology.

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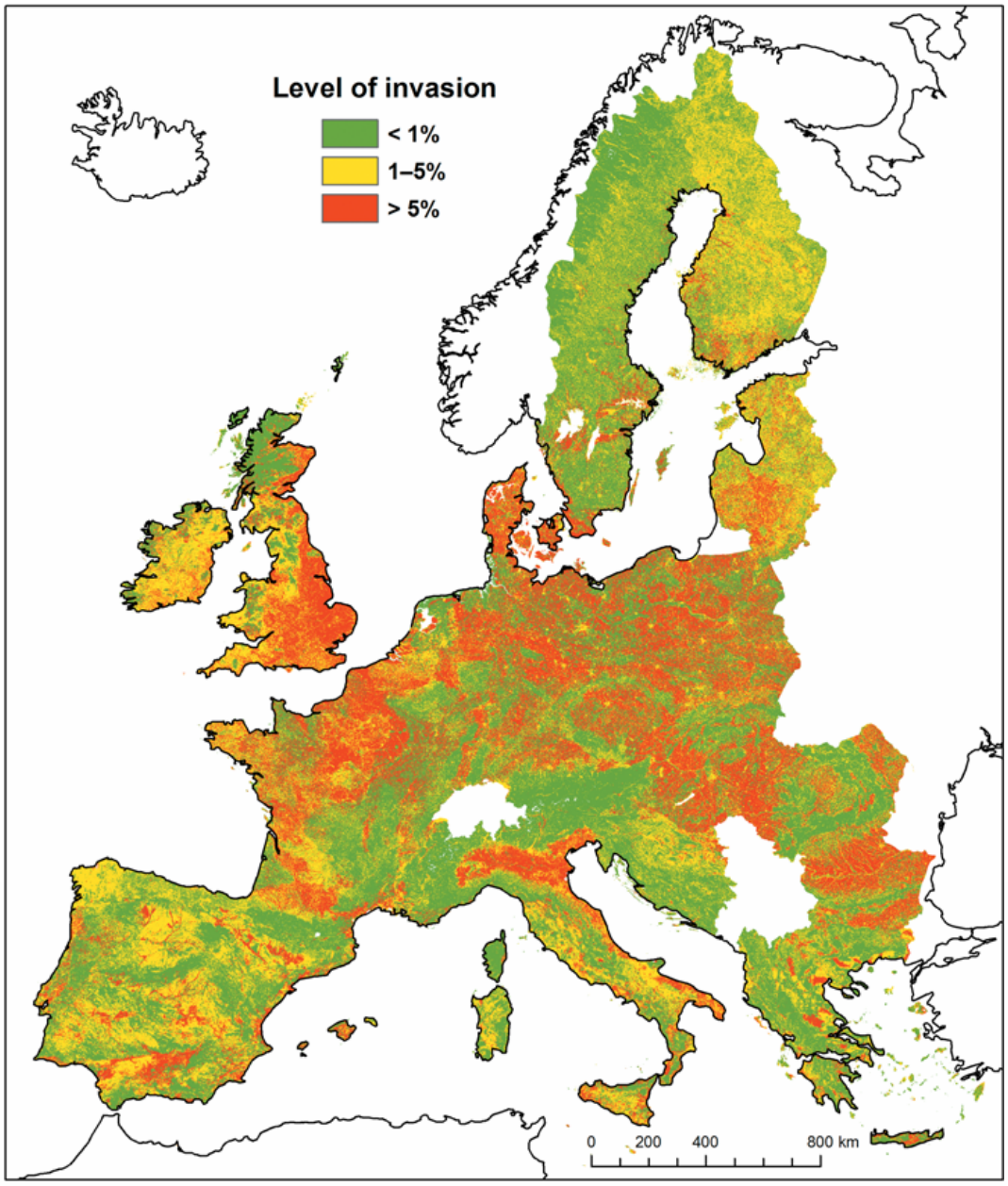
Habitat invasibility (plants, Europe)



Map of plant invasions in Europe based on invasibility of EUNIS habitats (translated to CORINE land-cover) in three biogeographical regions. Based on vegetation plot data from Chytrý et al., J. Appl. Ecol. 2007

Chytrý et al. 2009, Diversity & Distributions

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Socio-economic implications

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DAISIE reviewed impacts of invasives

1094 species with documented ecological impacts
1347 with economic impacts
Top of top 100 invasive species in Europe:

Canada geese (*Branta canadensis*)
Zebra mussels (Dreissena polymorpha)
Brook trout (*Salvelinus fontinalis*)
Bermuda buttercup (*Oxalis pes-caprae*)
Coypu (*Myocastor coypus*).

Vilá et al., Front. Ecol. Environ. 2009; doi:10.1890/080083

DAISIE reviewed costs of invasives

- Monetary cost of invasive alien species in Europe amounts to at least €10 billion per year.
- Terrestrial vertebrates produce the widest range of ecosystem impacts.
- Terrestrial invertebrates had the narrowest range of ecological effects,
  but wreaked the most financial havoc.
- Annual crop losses in the UK due to alien arthropods €2.8 billion.
- Cost of eradicating the 30 most common weeds could be more than €150 million.
- Among the most expensive invaders:
  - water hyacinth (€3.4 million)
  - coypu (€2.8 million)
  - a marina alga (€8.2 million).

Vilá et al., Front. Ecol. Environ. 2009; doi:10.1890/080083

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Aim at centralizing management for aliens in Europe

Current responsibilities for invasive species management, e.g.:

- European Environment Agency (EEA)
- European and Mediterranean Plant Protection Organisation (EPPO)
- European Food Safety Authority (EFSA)

  rarely communicate with each other

  the topic of invasions is only one of many areas of activity

→ European Centre for Invasive Species Management (ECISM):

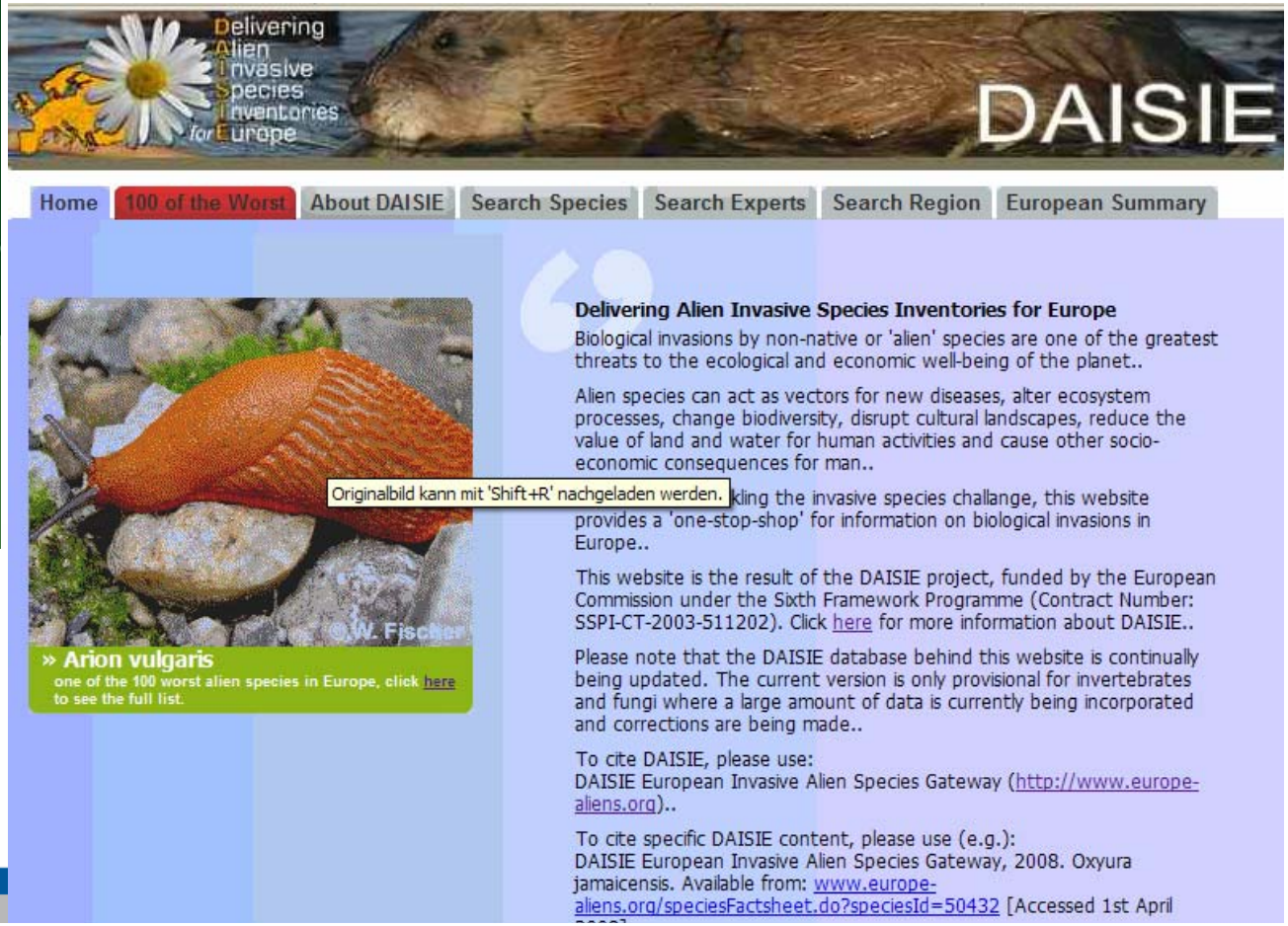
- Identify, assess and communicate current and emerging threats
- Coordinate activities across Member States,
- Building a Europe-wide surveillance system (monitoring)

Hulme et al., 2009, Science 324: 40-42

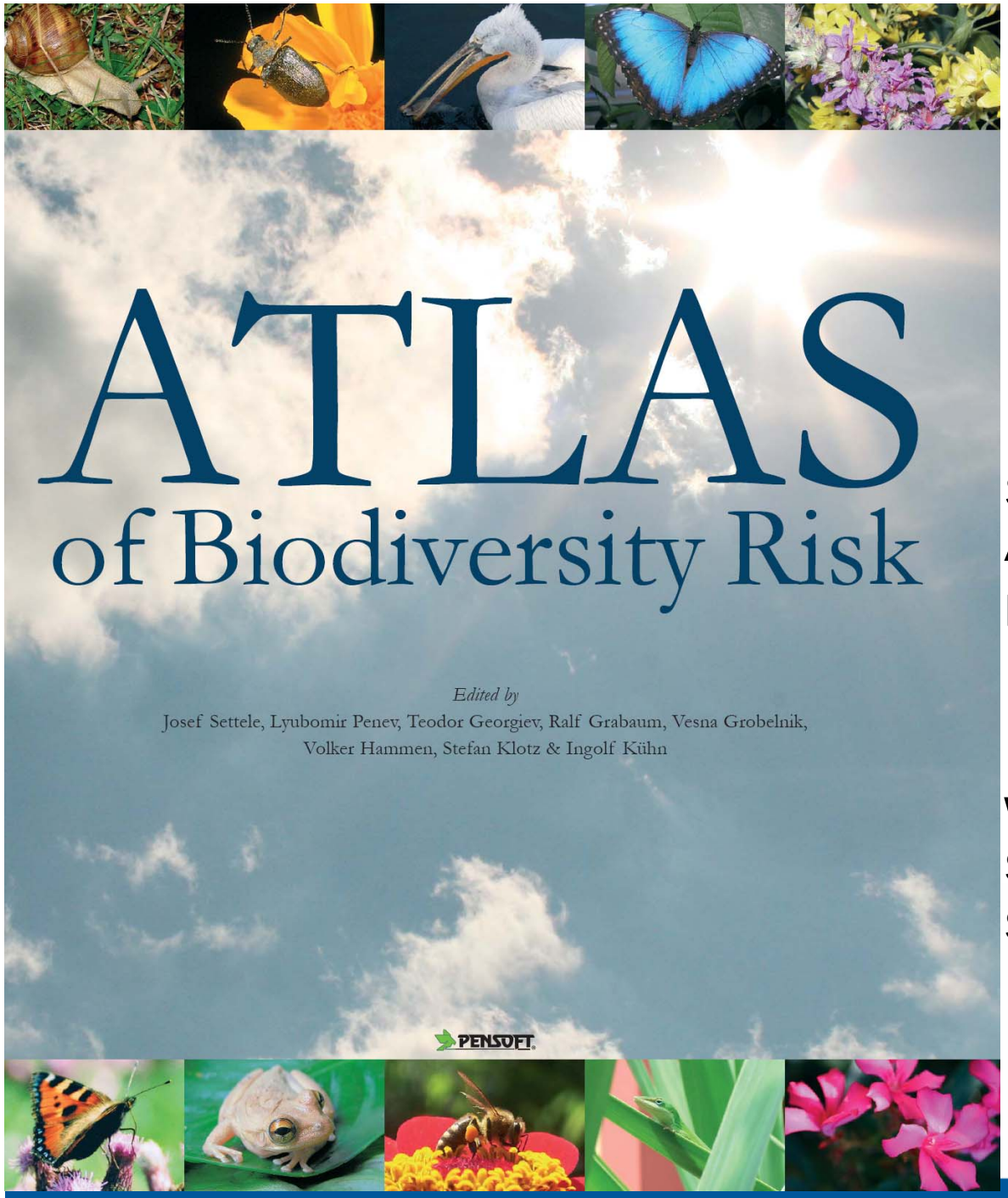
First European inventory of alien species

DAISIE (2009) Handbook of alien species in Europe. Springer, Dordrecht.
ISBN 978-1-4020-8279-5

http://www.europe-aliens.org/



Delivering Alien Invasive Species Inventories for Europe



Settele et al. (eds.):
Atlas of Biodeiversity Risk.
Pensoft Publishers, Sofia (BG),
In press.

www.alarmproject.net

Settele et al. 2005. Gaia 14;

Settele et al. 2007. Science 315.

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Acknowledgements

UFZ: Jan Hanspach, Eva Küster, Marten Winter, Stefan Klotz

EU-Projects
ALARM: Assessing LArge-scale environmental risks for biodiversity with tested methods www.alarmproject.net, for providing scenarios, coordinator: J. Settele
DAISIE: Delivering Alien Invasive Species Inventories for Europe http://www.europe-aliens.org, coordinators: P. Hulme, D. Roy.

Thank you for your attention!

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