



Invasion pathways, species invasion success and habitat invasibility in Europe

Ingolf Kühn

Helmholtz Centre for Environmental Research – UFZ

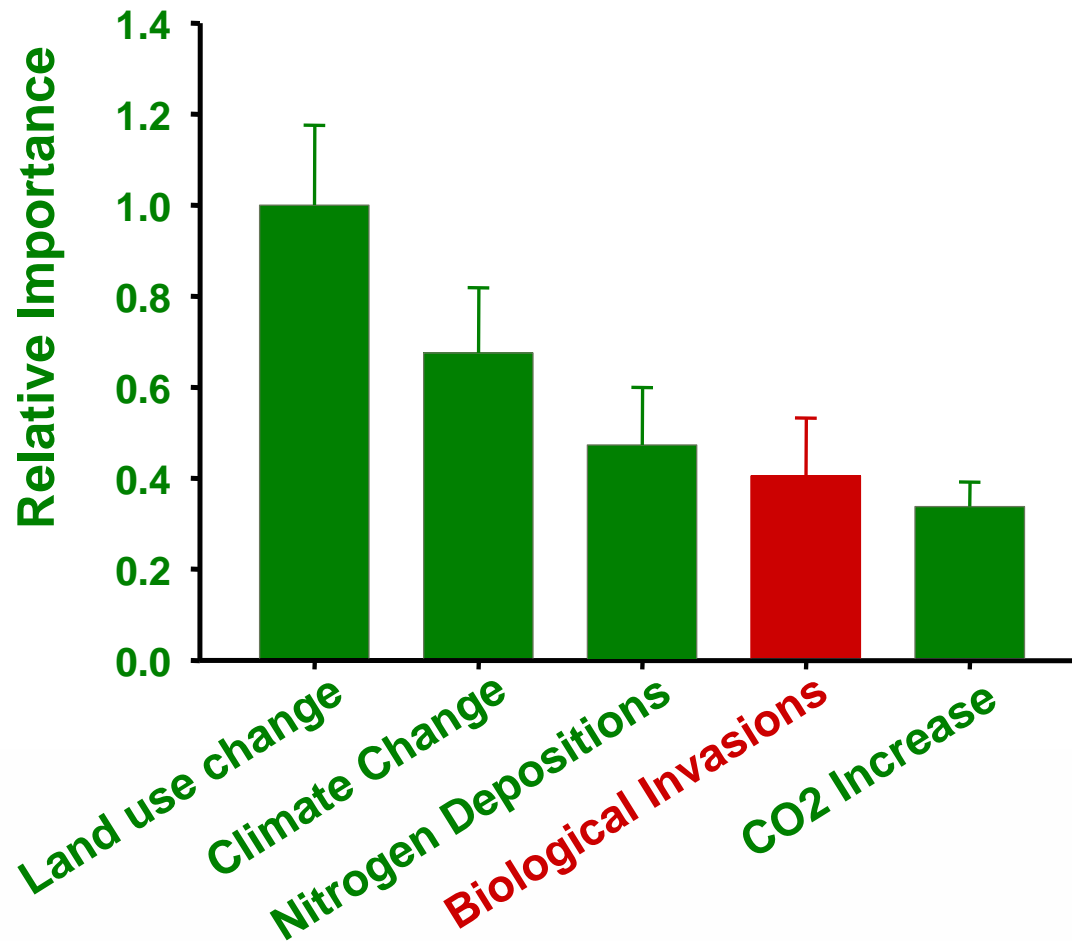
Dept. Community Ecology

ingolf.kuehn@ufz.de



**HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH – UFZ**

Biological Invasions and the Biodiversity Crisis



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

Comparative analyses in invasion biology

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

Problems with such comparative analyses

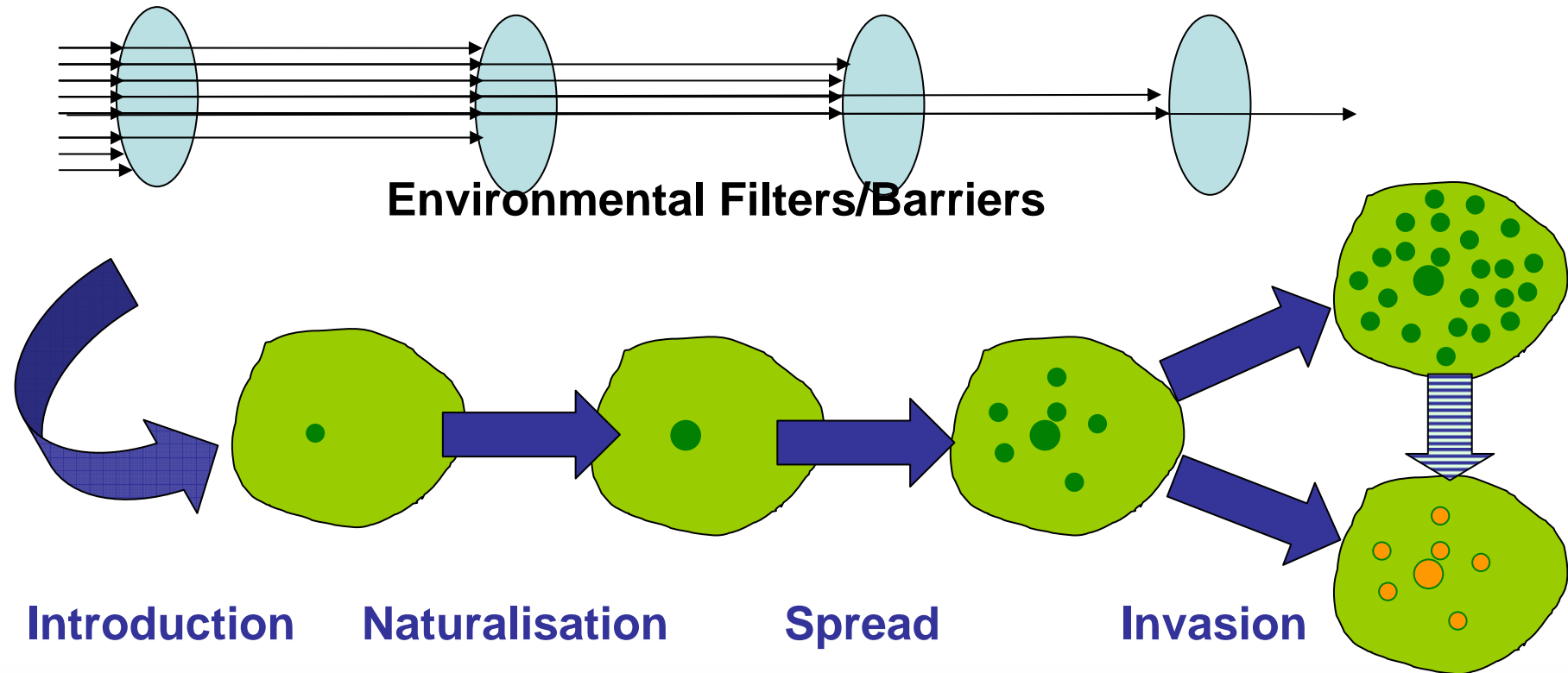
- Confounding invasibility with invader pools
- Confounding invasibility with propagule pressure
- Confounding invasibility with invasiveness
- Spatial non-independence of introduction events
- Phylogenetic non-independence of introduction events

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

Invasiveness of species:

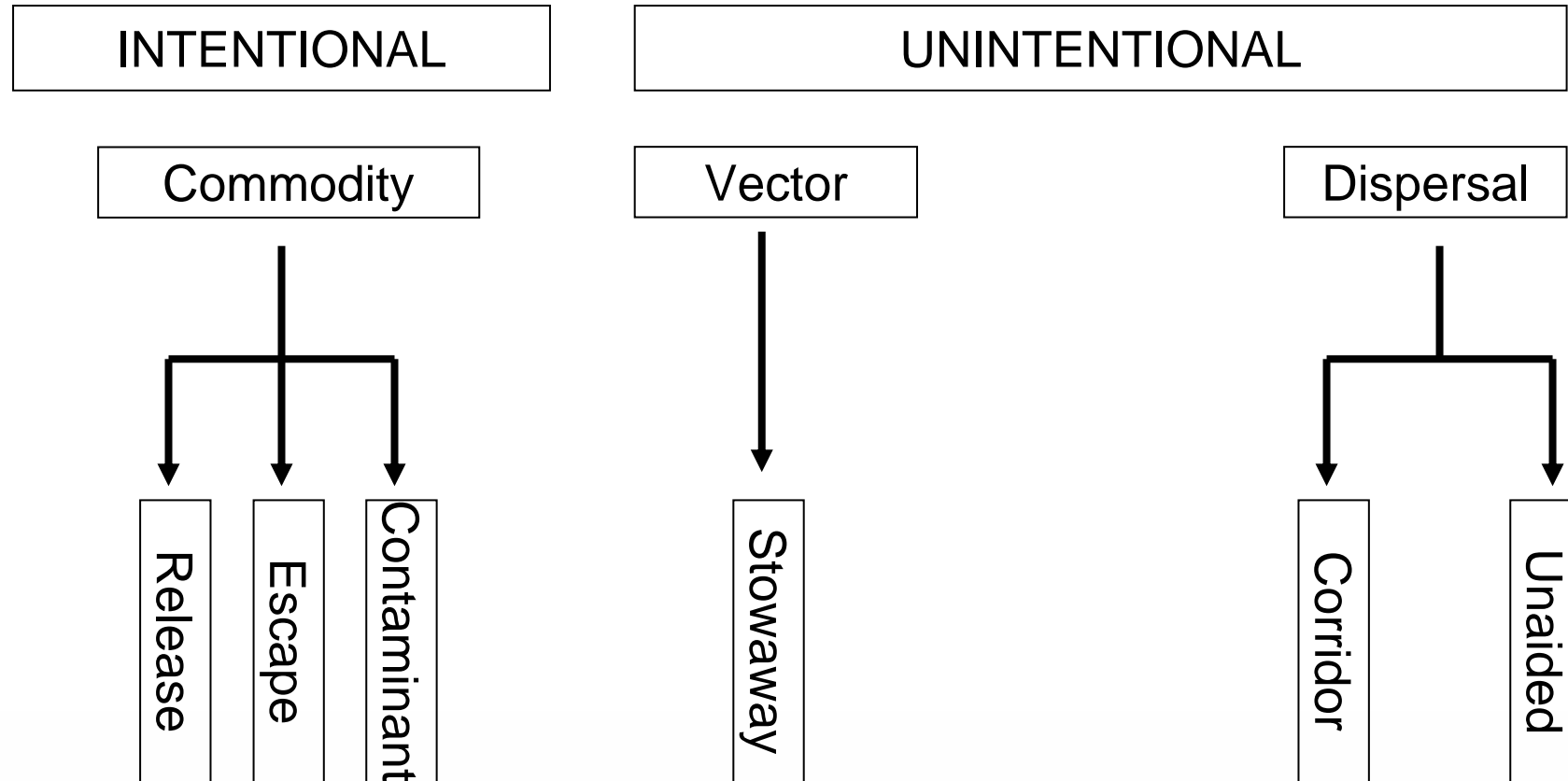
Pathway of introduction

Steps of the invasion process



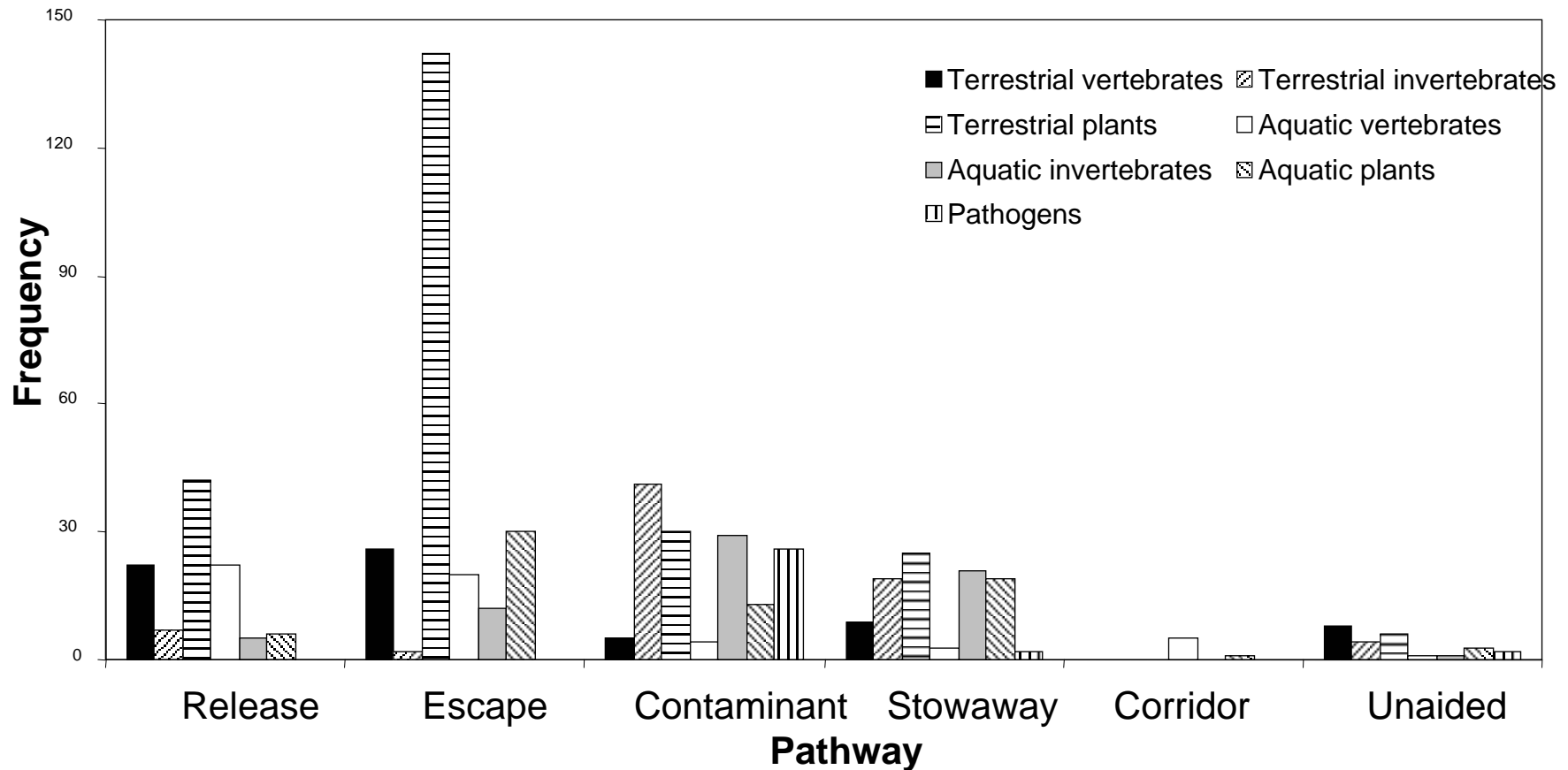
See Richardson et al. 2000, Heger 2001, Rahel 2002,
Colautti & MacIsaac 2004, Hulme 2004, Pyšek et al. 2004

Pathways of Biological Invasions



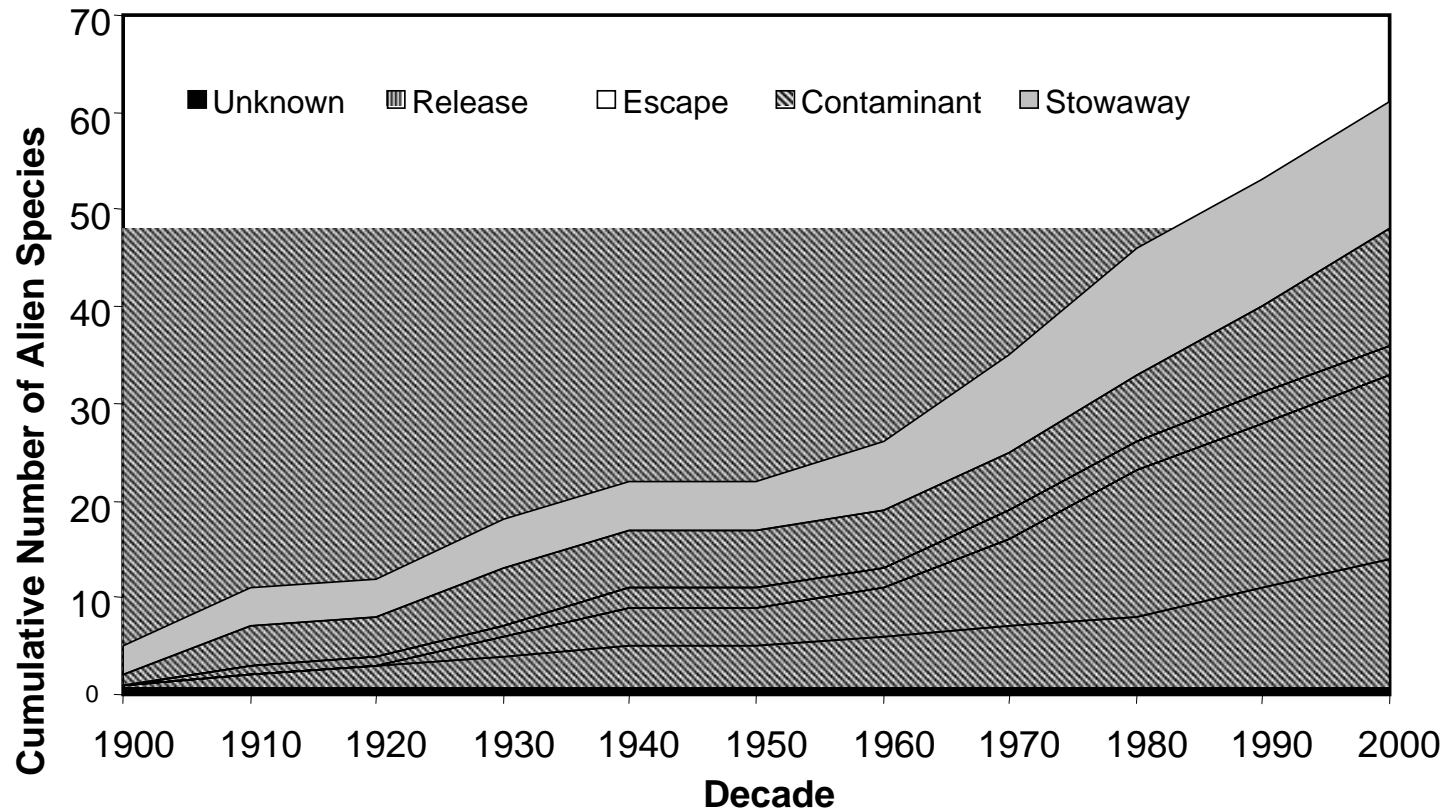
Hulme et al. 2008, J. Appl. Ecol. 45: 403–414

Frequency of pathways



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

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/>)

Naturalisation rate of terrestrial alien species in Europe

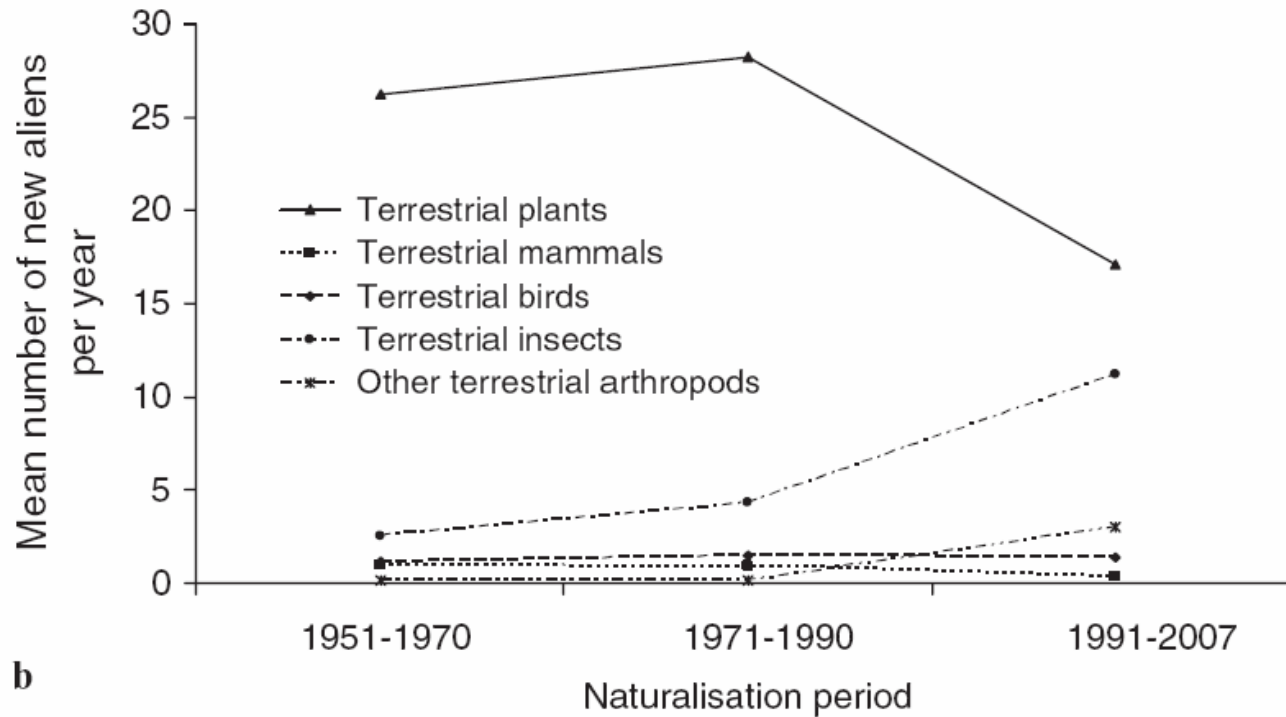
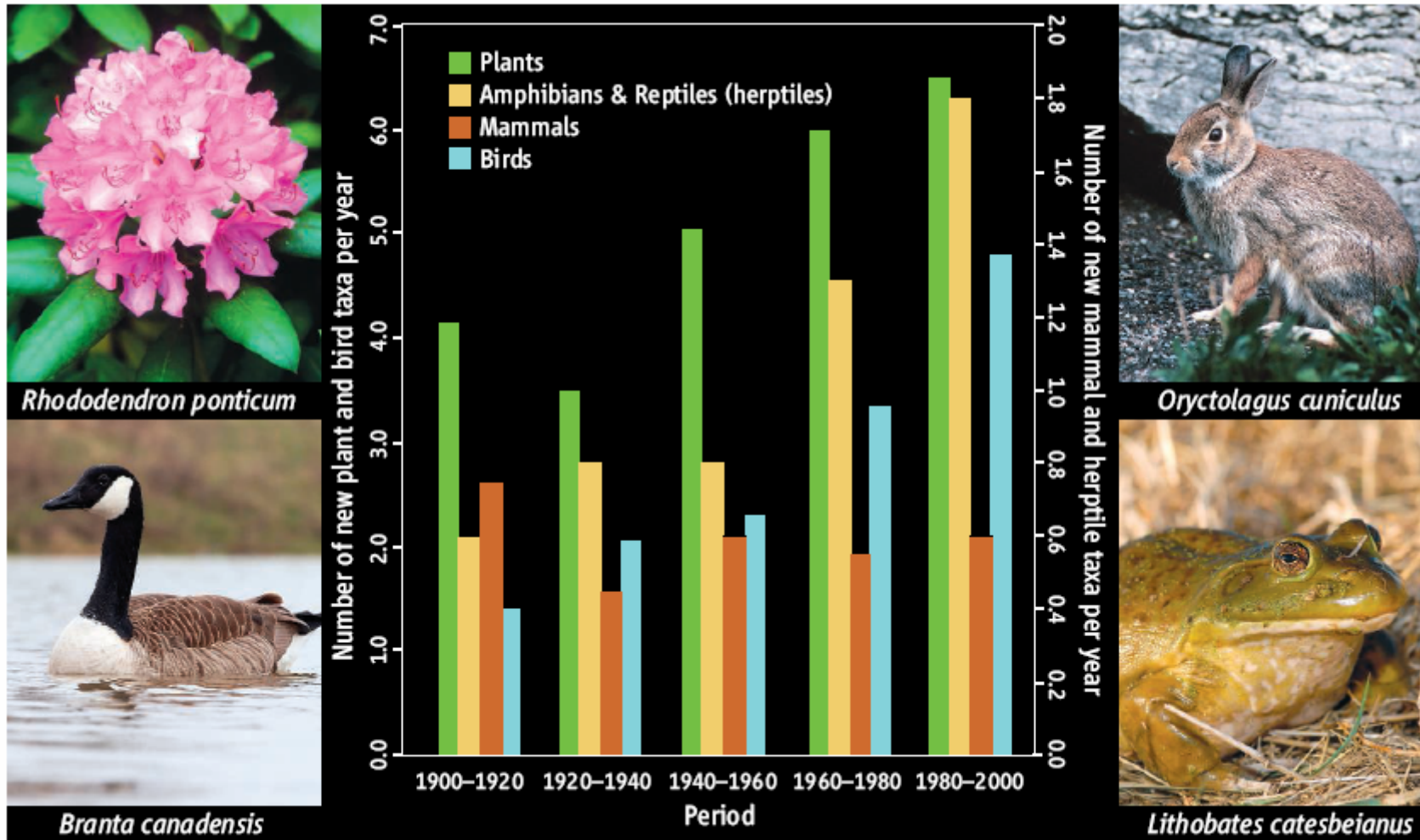


Fig. 1.3 Pan-European trends in the average number of new alien plants, invertebrate, fish, birds and mammals naturalising in Europe per year in three time periods 1951–1970; 1971–1990 and 1991–2007 in (a) aquatic and (b) terrestrial environments

Numbers of established alien species in Europe

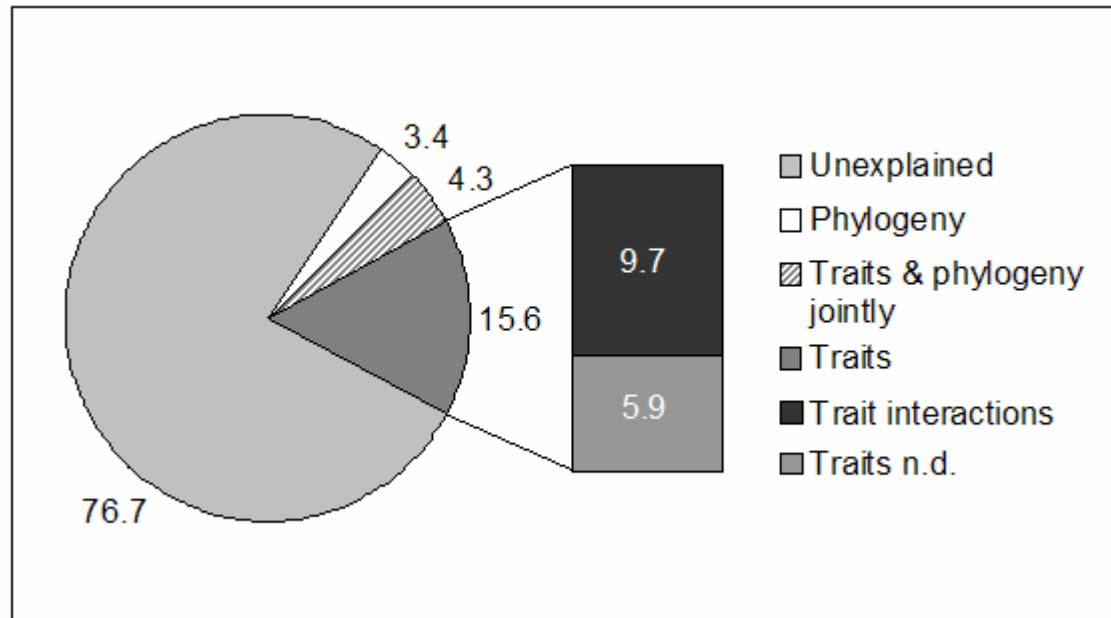


DAISIE 2008, Handbook of Alien Species in Europe. Springer.
 Hulme et al., 2009, Science 324: 40-42

Invasiveness of species:

Species characteristics

Trait interactions are important!



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

Propagule pressure ?

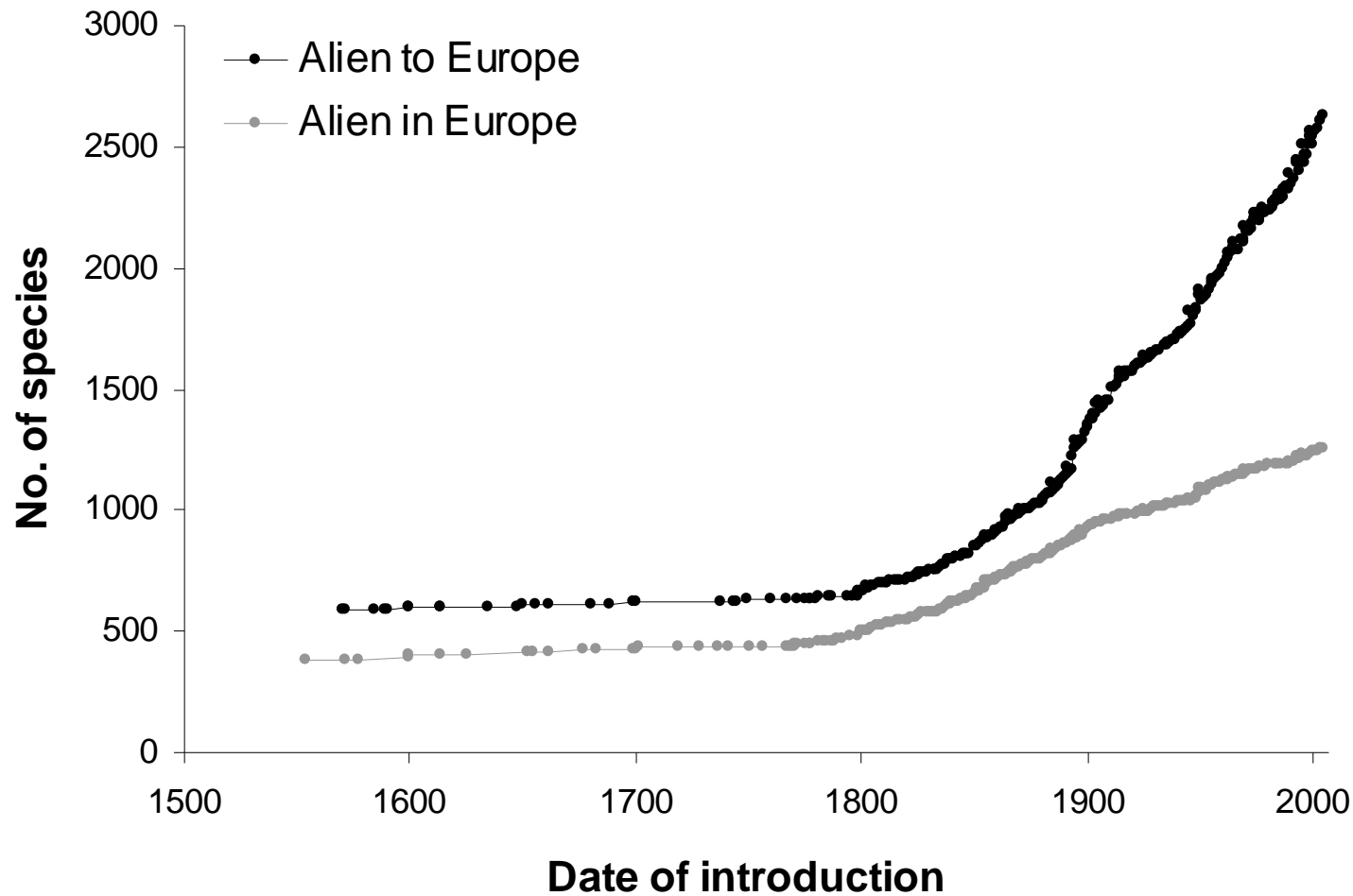
| explaining variable | Chi² | Df | p-value |
|----------------------------------|------------------------|-----------|----------------|
| hardiness | 10.002 | 1 | <0.001 |
| growth form | 24.204 | 2 | <0.001 |
| plant height | 4.381 | 1 | <0.05 |
| number of continents | 12.343 | 1 | <0.001 |
| number 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:

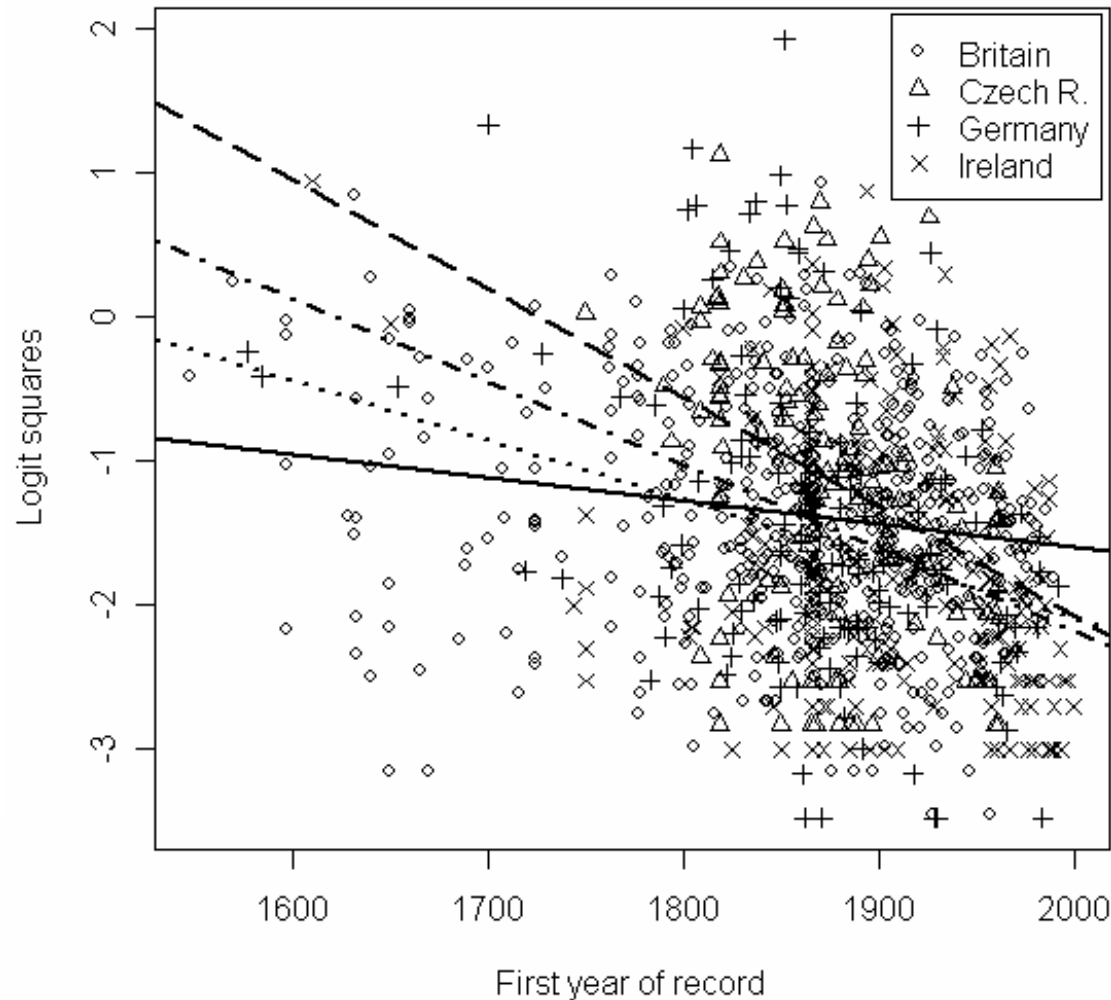
Time of introduction

Temporal dynamics of invasions in Europe



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

Time since introduction and invasion success



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

Time to full distribution (range filling)

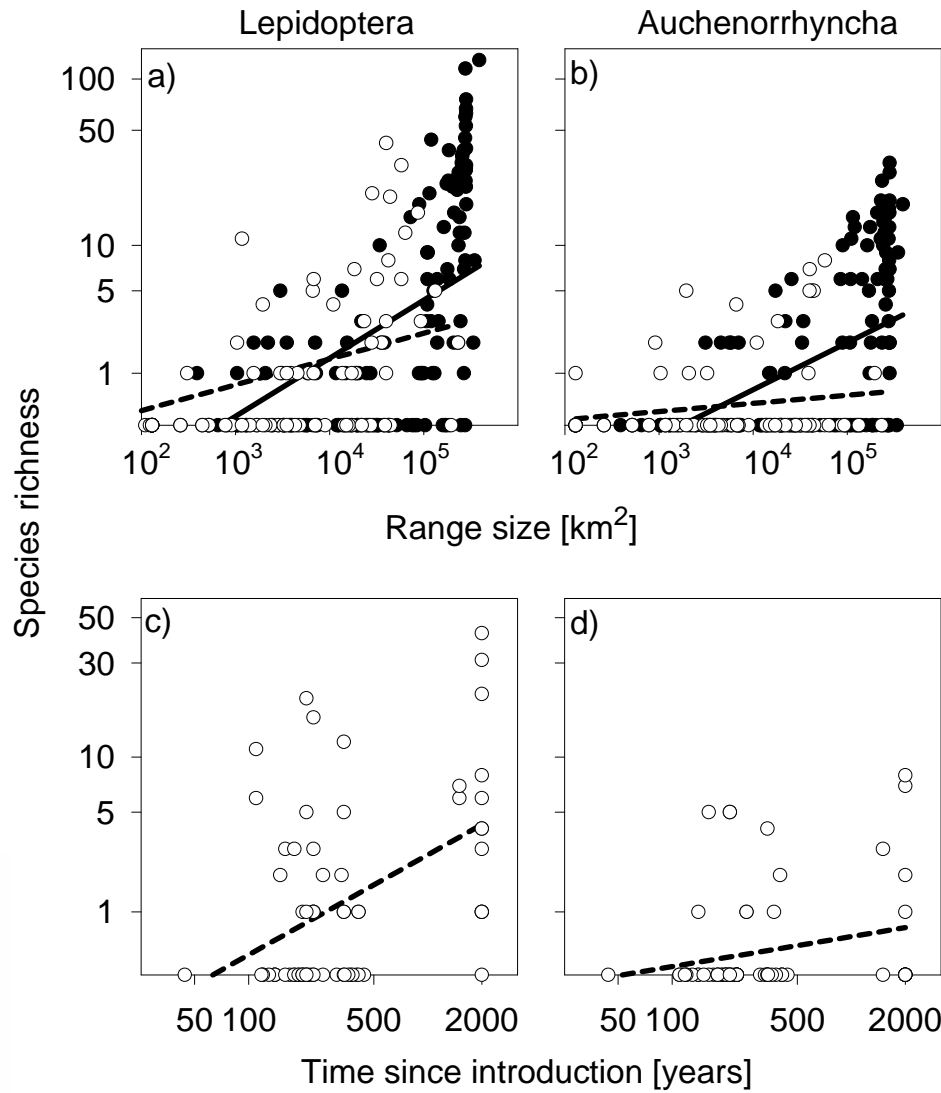
| | years until | | years until | |
|----------------|-------------|-------|-------------|-------|
| | regression | s.e. | RMA | s.e. |
| Ireland | 290 | 42.64 | 151 | 17.02 |
| Britain | 351 | 57.98 | 177 | 23.75 |
| Germany | 166 | 16.94 | 145 | 15.60 |
| Czech Republic | 160 | 14.02 | 141 | 12.26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

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



HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH - UFZ

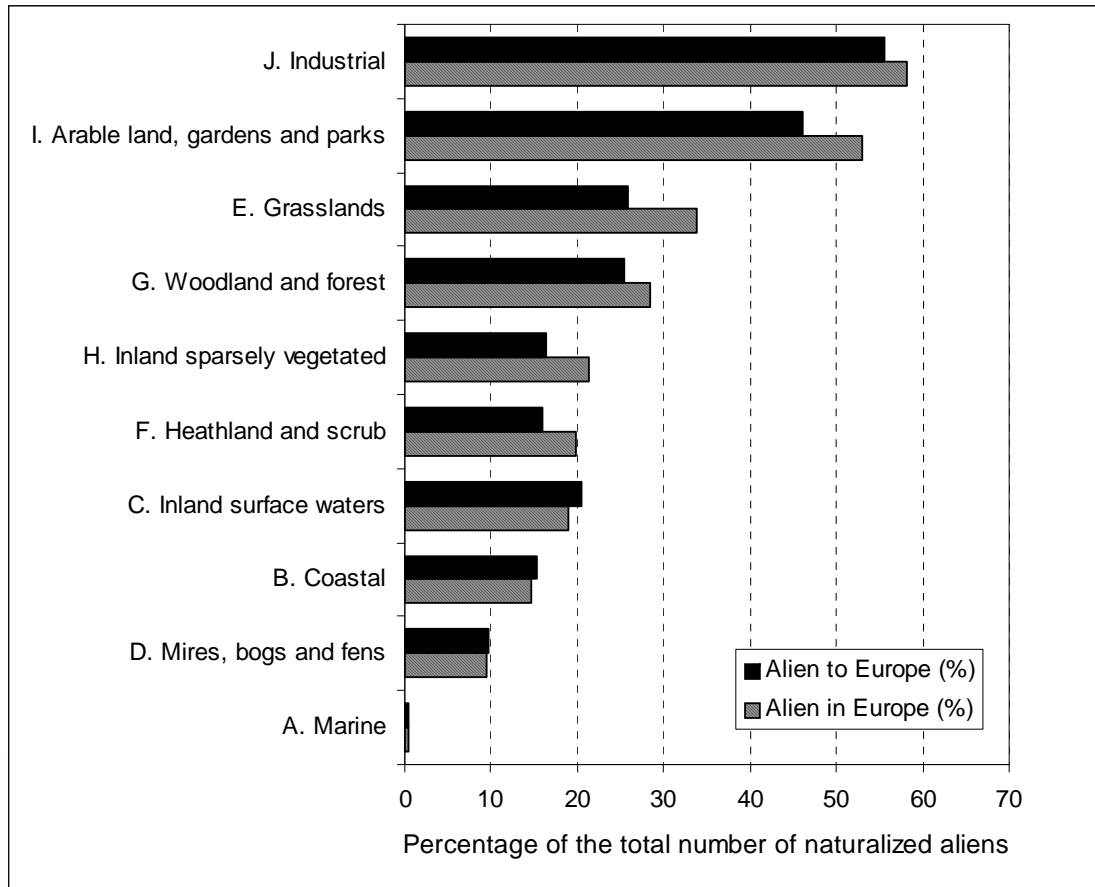
Invasions in herbivores



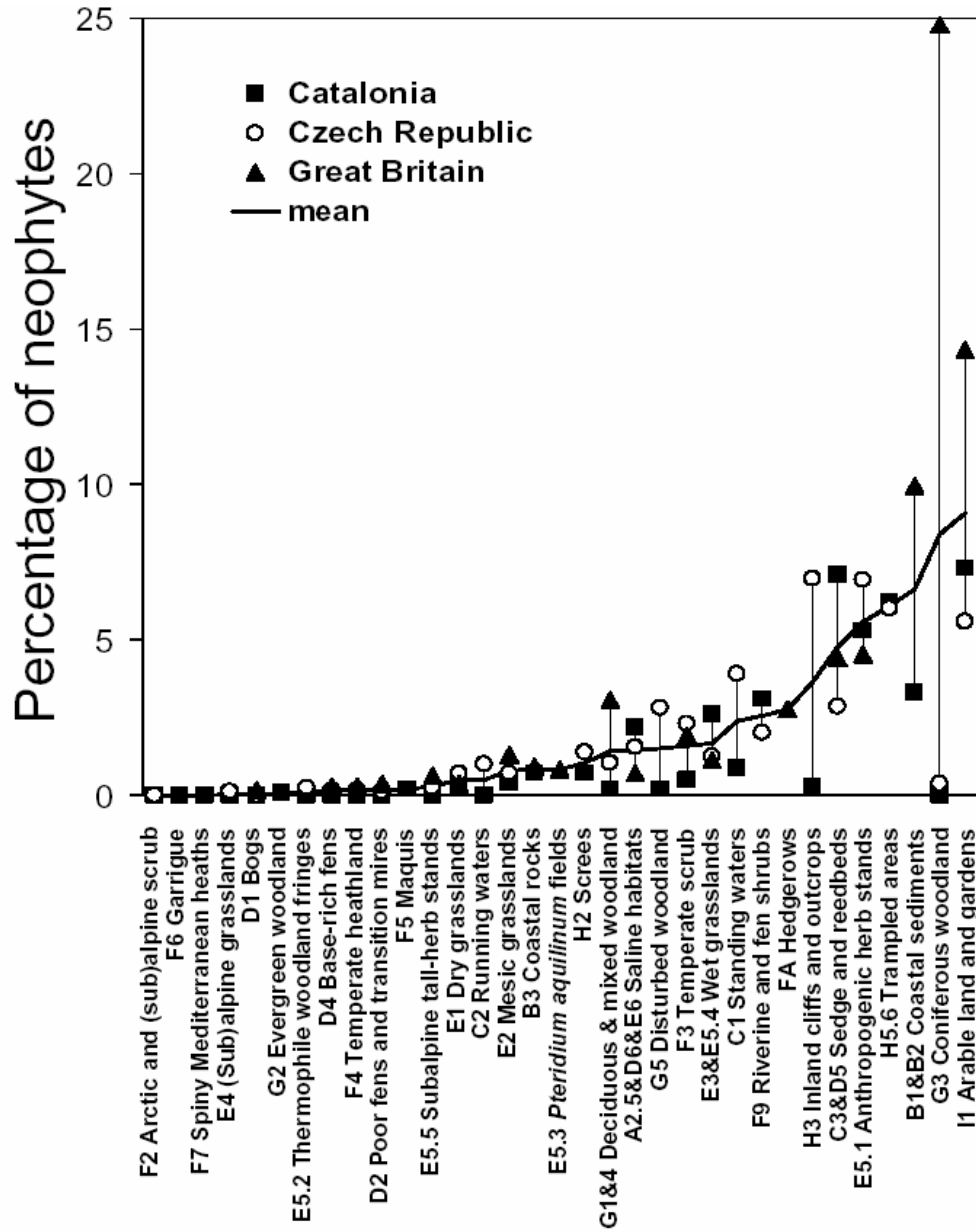
Brändle, Kühn et al. 2008, *Diversity & Distributions* 14: 905-912

Invasibility of ecosystems/habitats

Distribution of European naturalized aliens in EUNIS habitats



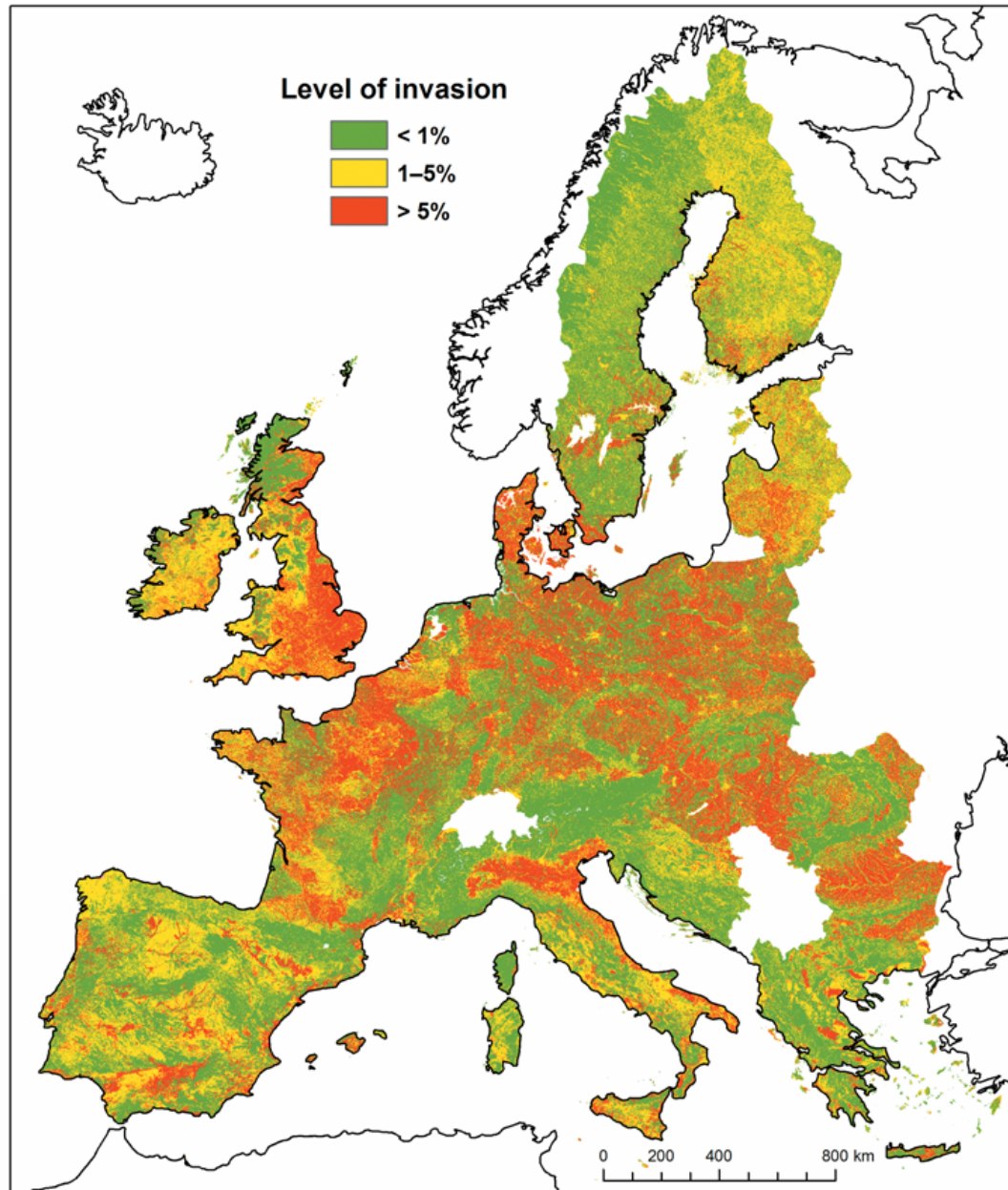
Lambdon et al. 2008, Preslia 80: 101-149



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.

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

Socio-economic implications

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

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/>



Home **100 of the Worst** About DAISIE Search Species Search Experts Search Region European Summary



>> **Arion vulgaris**
one of the 100 worst alien species in Europe, click [here](#) to see the full list.

Originalbild kann mit 'Shift+R' nachgeladen werden.

© W. Fischer



Delivering Alien Invasive Species Inventories for Europe

Biological invasions by non-native or 'alien' species are one of the greatest threats to the ecological and economic well-being of the planet..

Alien species can act as vectors for new diseases, alter ecosystem processes, change biodiversity, disrupt cultural landscapes, reduce the value of land and water for human activities and cause other socio-economic consequences for man..

Facing the invasive species challenge, this website provides a 'one-stop-shop' for information on biological invasions in Europe..

This website is the result of the DAISIE project, funded by the European Commission under the Sixth Framework Programme (Contract Number: SSPI-CT-2003-511202). Click [here](#) for more information about DAISIE..

Please note that the DAISIE database behind this website is continually being updated. The current version is only provisional for invertebrates and fungi where a large amount of data is currently being incorporated and corrections are being made..

To cite DAISIE, please use:

DAISIE European Invasive Alien Species Gateway (<http://www.europe-aliens.org>)..

To cite specific DAISIE content, please use (e.g.):
DAISIE European Invasive Alien Species Gateway, 2008. *Oxyura jamaicensis*. Available from: www.europe-aliens.org/speciesFactsheet.do?speciesId=50432 [Accessed 1st April 2009]





ATLAS

of Biodiversity Risk

Edited by

Josef Settele, Lyubomir Penev, Teodor Georgiev, Ralf Grabaum, Vesna Grobelnik,
Volker Hammen, Stefan Klotz & Ingolf Kühn

 PENSOFT



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

www.alarmproject.net

Settele et al. 2005. Gaia 14;

Settele et al. 2007. Science 315.

 **HELMHOLTZ**
CENTRE FOR
ENVIRONMENTAL
RESEARCH - UFZ



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!