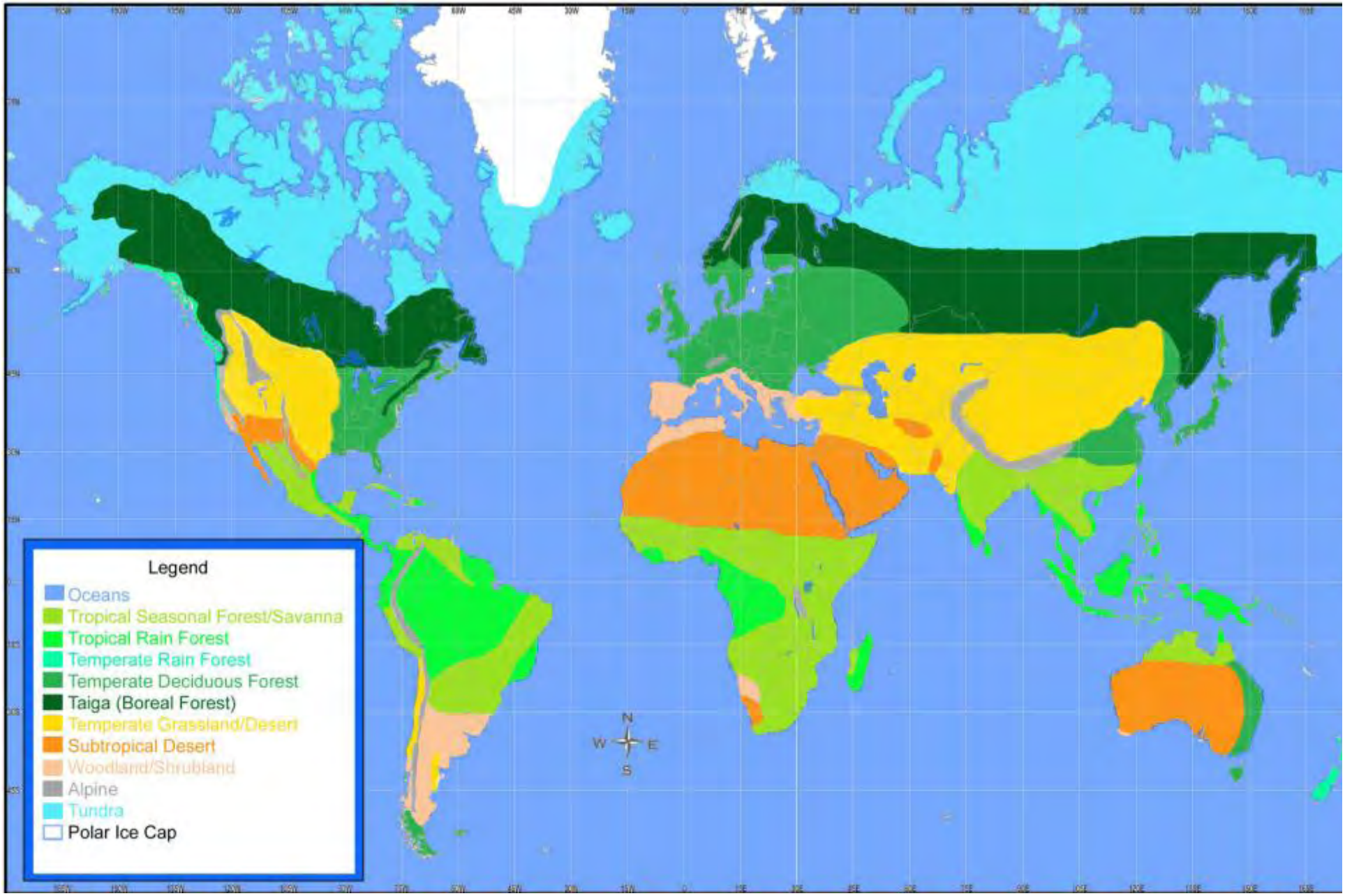
Impacts of biological invasions

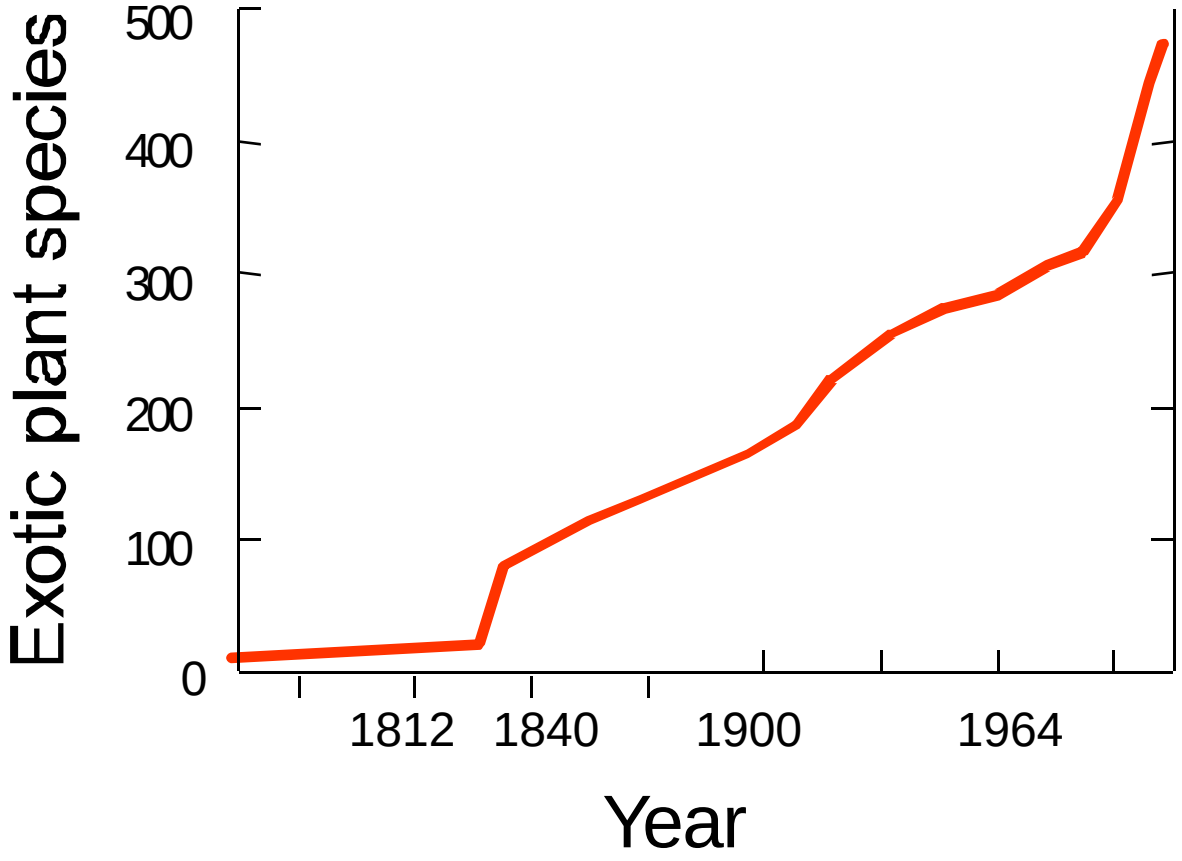
Montserrat Vilà

OT-Med Conference
Marseille, December 17, 2012


Legend
Oceans
Tropical Seasonal Forest/Savanna
Tropical Rain Forest
Temperate Rain Forest
Temperate Deciduous Forest
Taiga (Boreal Forest)
Temperate Grassland/Desert
Subtropical Desert
Woodland/Shrubland
Alpine
Tundra
Polar Ice Cap
N
W
E
S

Pathways of introduction

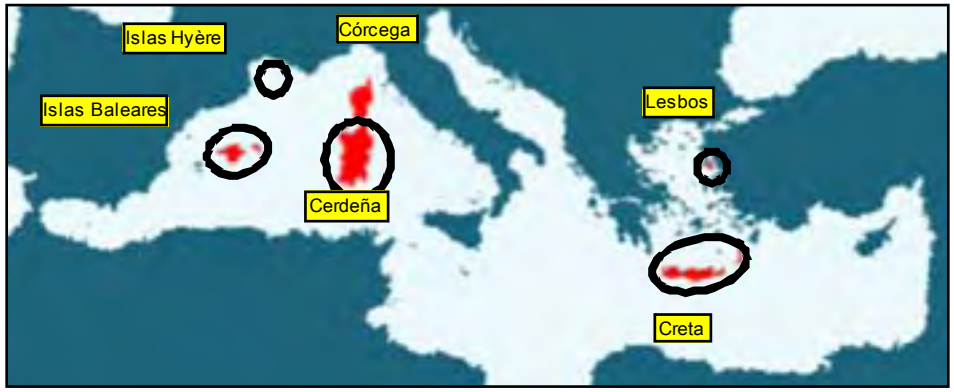

OPDR
OPDR
OPDR
OPDR
TMS
Terminales Marítimos de Sevilla, S.A.

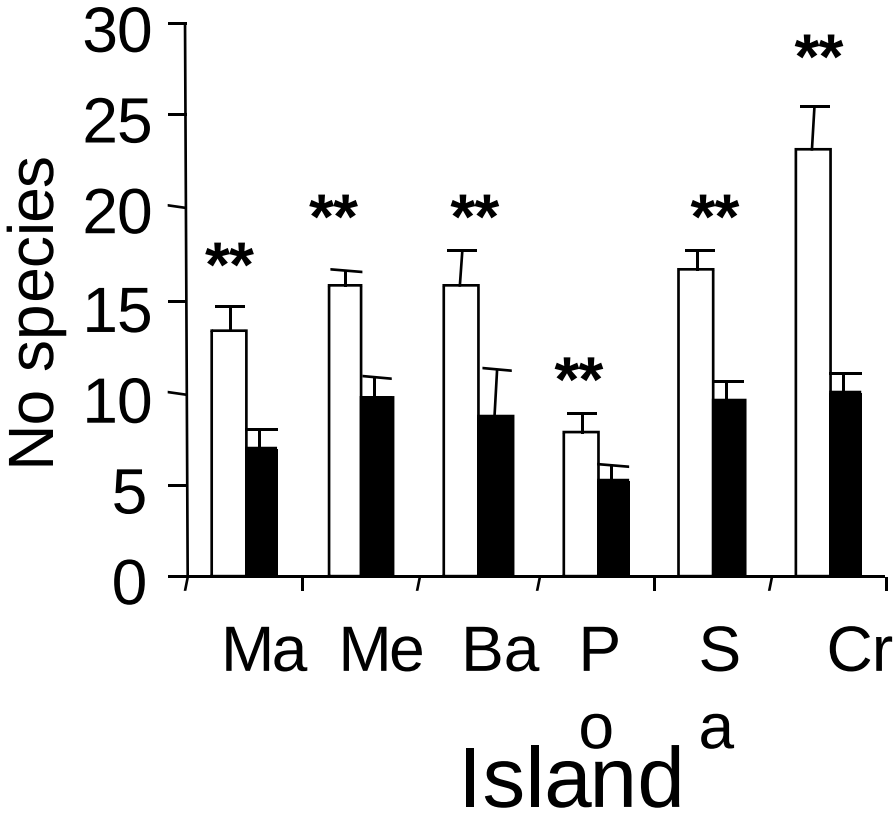


(Modified from Jeanmonod 1998)

Decrease in diversity

EPIDEMIE





(Vilà et al. 2006)

Disruption of trophic networks

Dreissena polimorpha

Procambarus clarkii

Acacia spp.

Robinia pseudoacacia

(Foto: Sanz_Elorza et al 2004)

Changes in ecosystem functioning

Myrica faya

N source (kg/ha/any)	*M. Faya* No	*M. Faya* Yes
Raining	5	5
Natural N-fixing	<0.6	<0.7
M. faya N-fixing	0	18
Total	5.5	23.5

1) Glonal analysis of alien plant impacts

2) European assessment of alien species impacts

1) Glonal analysis of alien plant impacts

2) European assessment of alien species impacts

Objectives

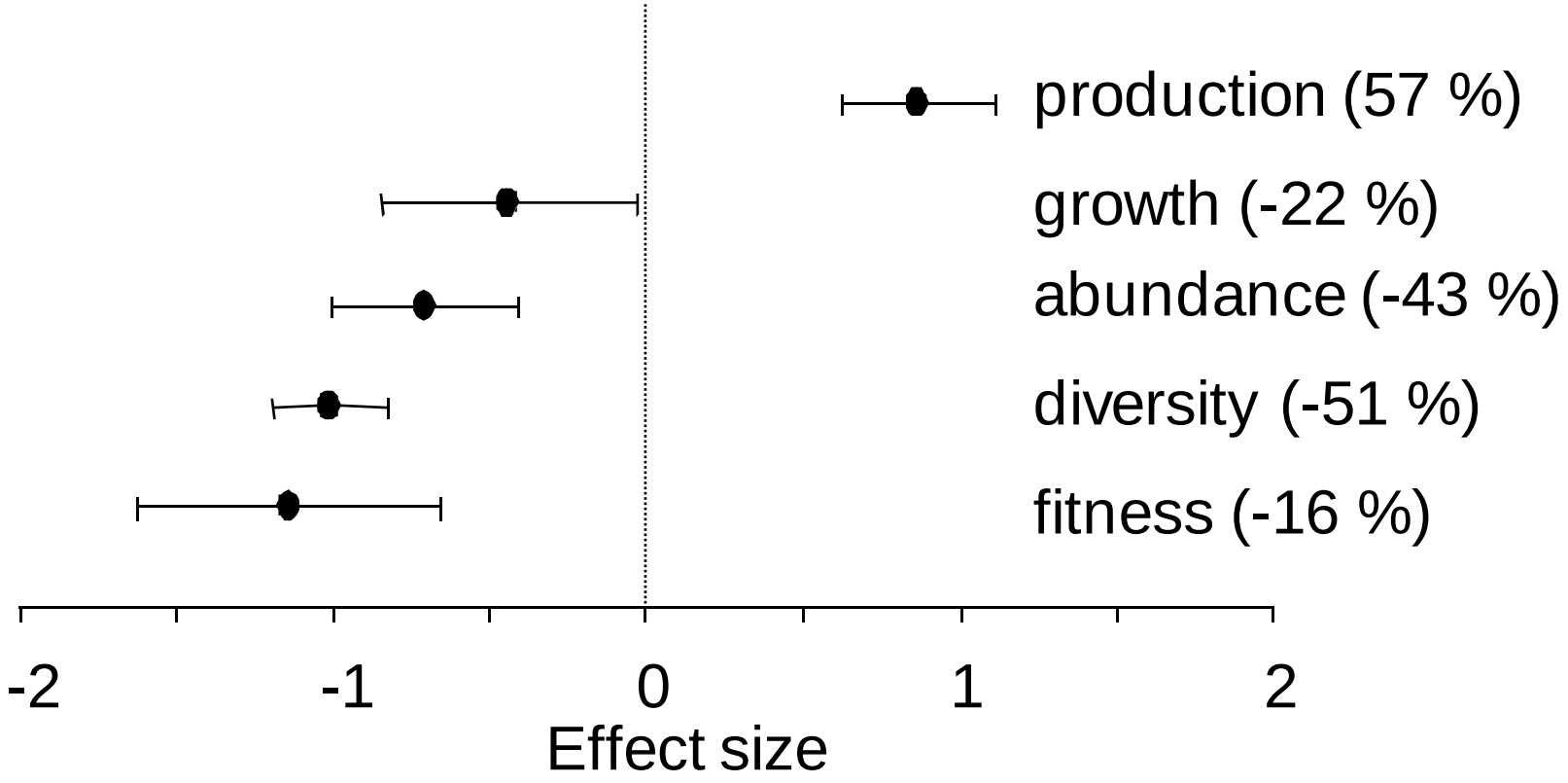
- Quantify the magnitude of their effects on species, communities and ecosystems.

- Compare differences between N-fixing and non N-fixing species.

Methods

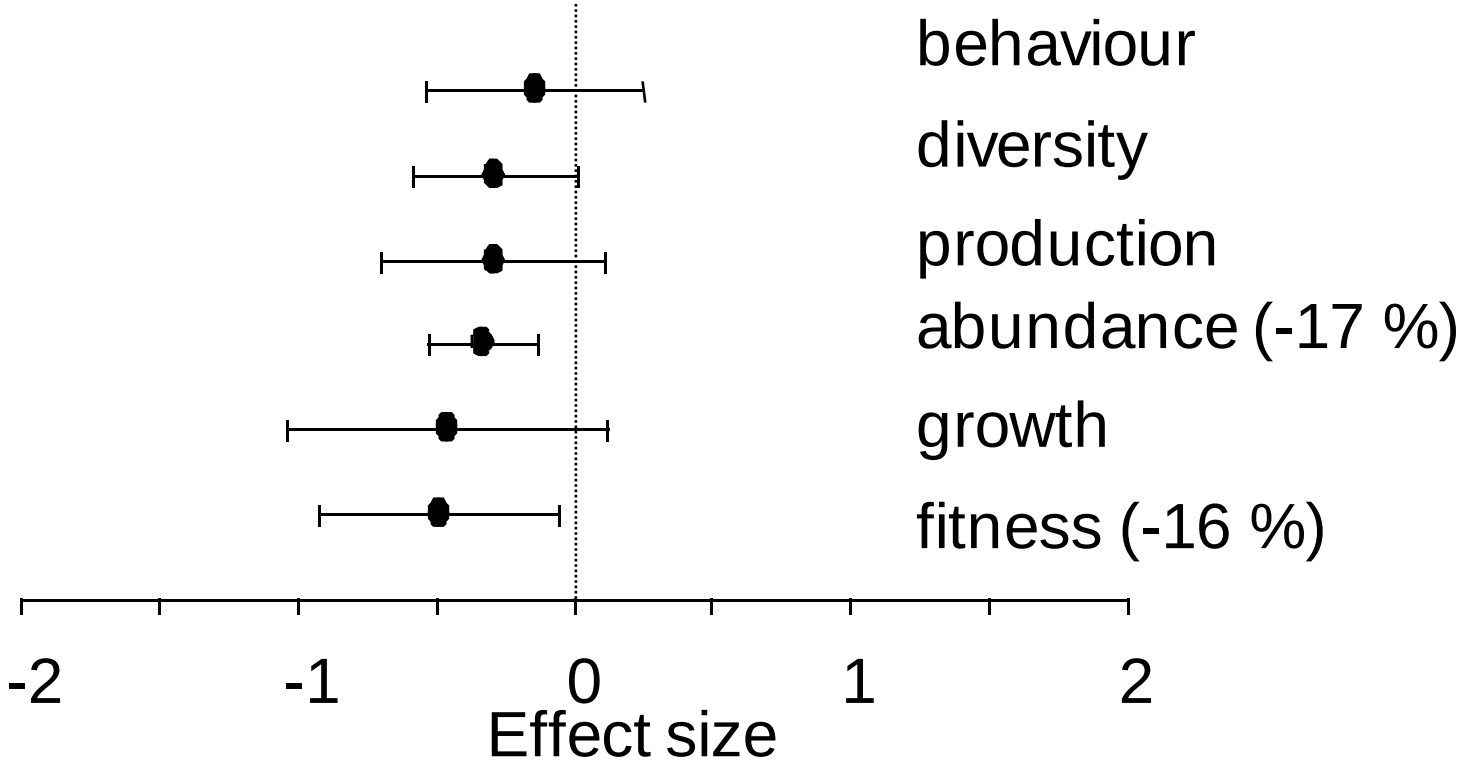
- Screening 533 SCI articles:
  - 199 articles
  - 1041 field studies for 135 alien plant taxa
  - 24 ecological impact types
- Meta-analysis (Hedges' d)

Effects on plants



Vilà et al. (2011) *Ecology Letters*

Effects on animals



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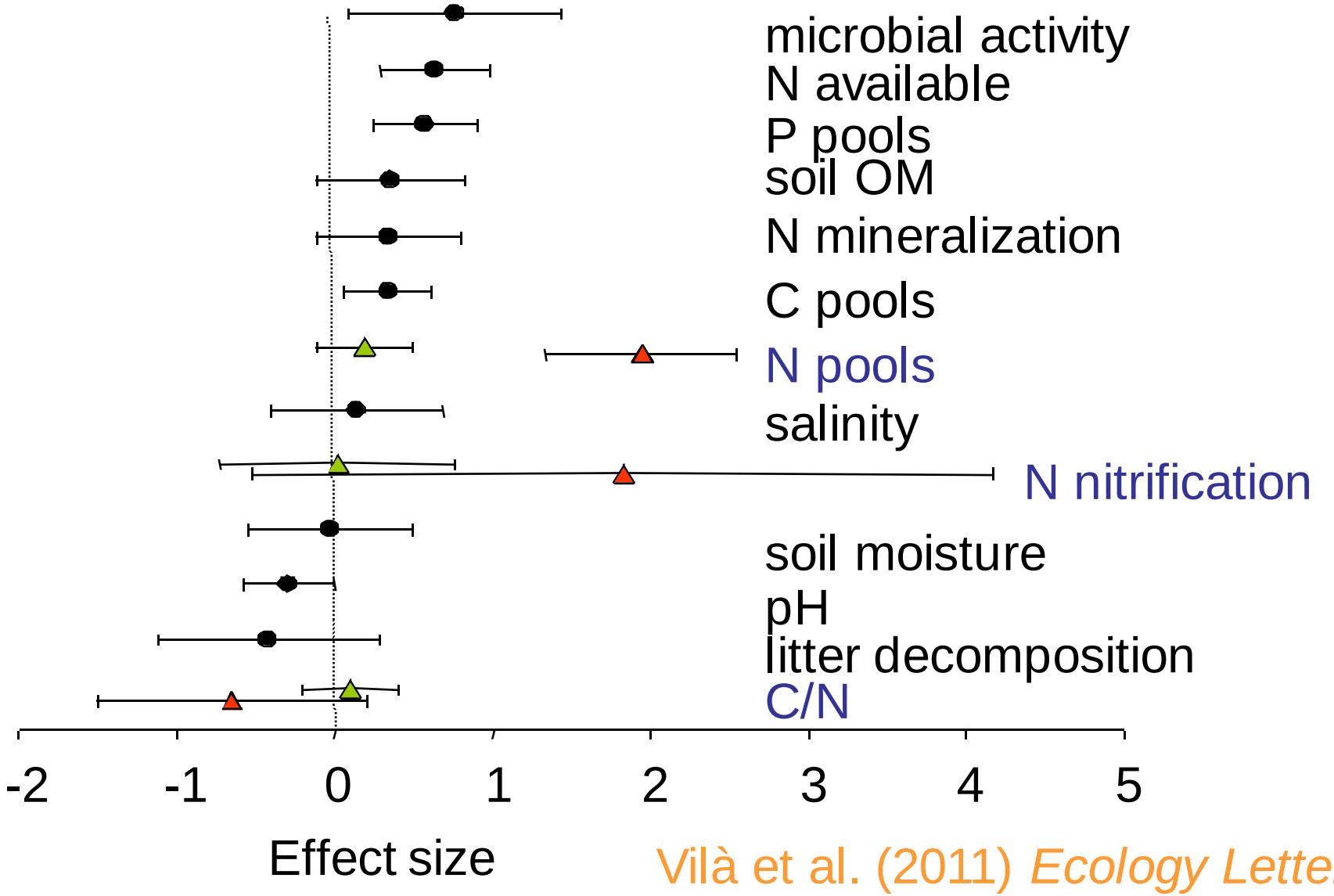
Effects on ecosystems

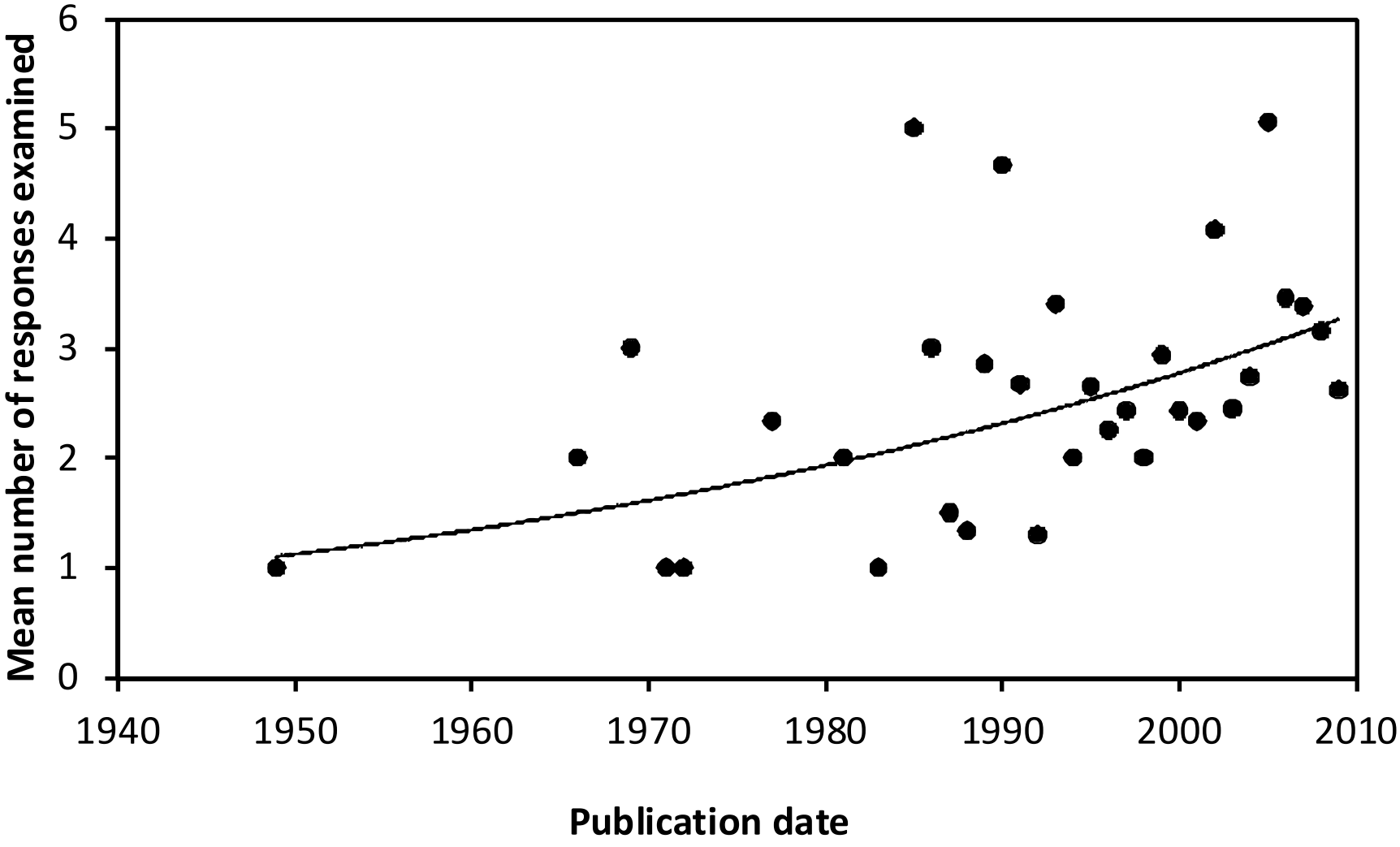


Vilà et al. (2011) *Ecology Letters*

Conclusions

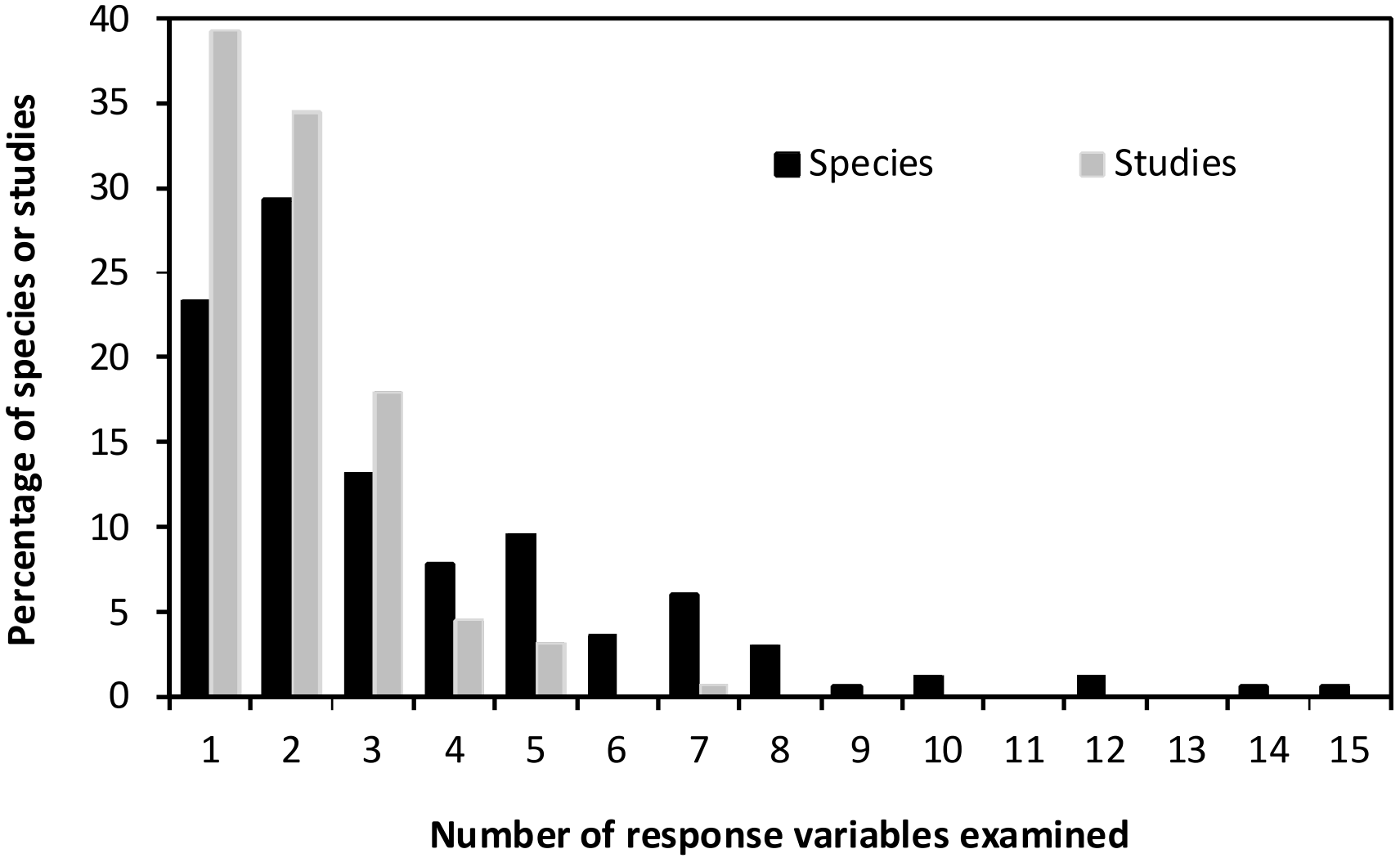
- Magnitude and direction varied between and within impact types (5 orders magnitude).
- Consistent change in 13 out if 24 impact types.
- Largest on plant production, diversity and N availability.
- N-fixing species impact on N cycling.

Number of impacts through time



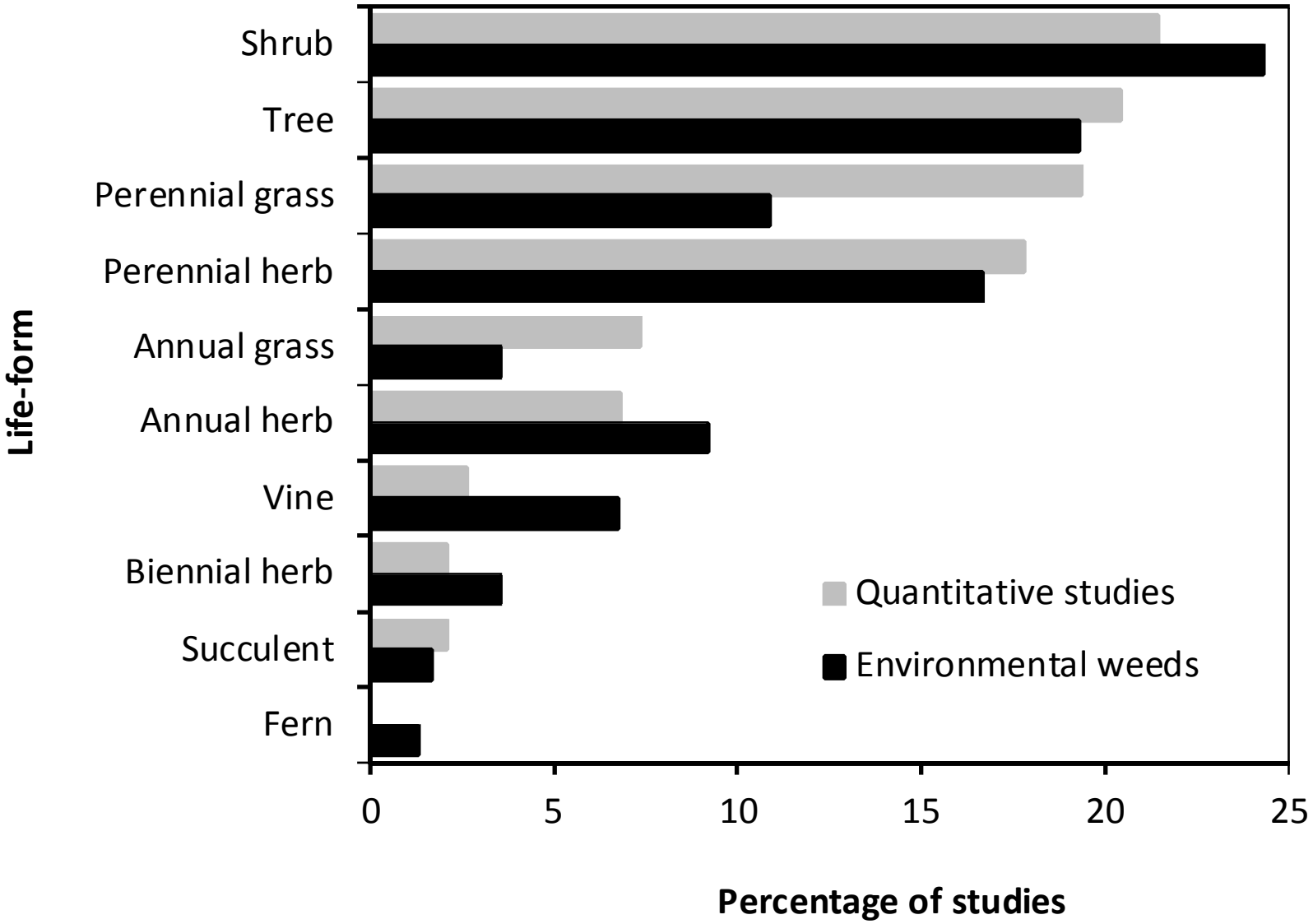
Hulme et al. Trends in Ecology & Evolution (in press)

Number of impacts

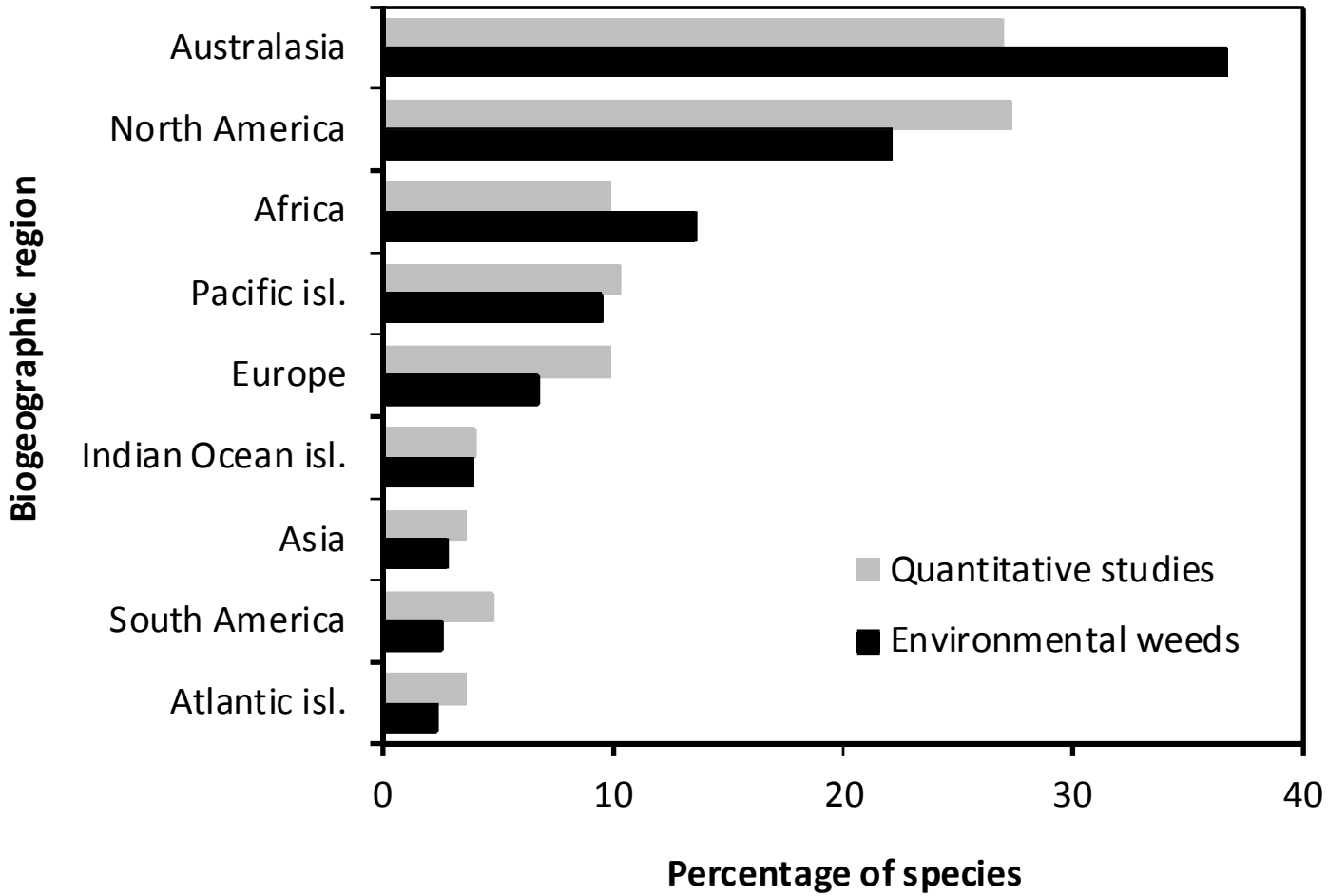


Hulme et al. Trends in Ecology & Evolution (in press)

Live-form bias



Geographic bias



Hulme et al. Trends in Ecology & Evolution (in press)

1) Glonal analysis of alien plant impacts

2) European assessment of alien species impacts


DAISIE - 100 of the Worst - Microsoft Internet Explorer
DAISIE
Home
About DAISIE
Search Species
Search Experts
Search Region
European Summary
100 of the Worst
Order by Name
Show Aquatic Marine
Show Aquatic Inland
Show Terrestrial Fungi
Show Terrestrial Invertebrates
Show Terrestrial Plants
Show Terrestrial Vertebrates
Acacia dealbata
Aedes albopictus
daisie
experts registry
1: Data source identified
2: Data acquired and a deadline for submission agreed
3: A provisional data set submitted
4: Final species list submitted
0, No data

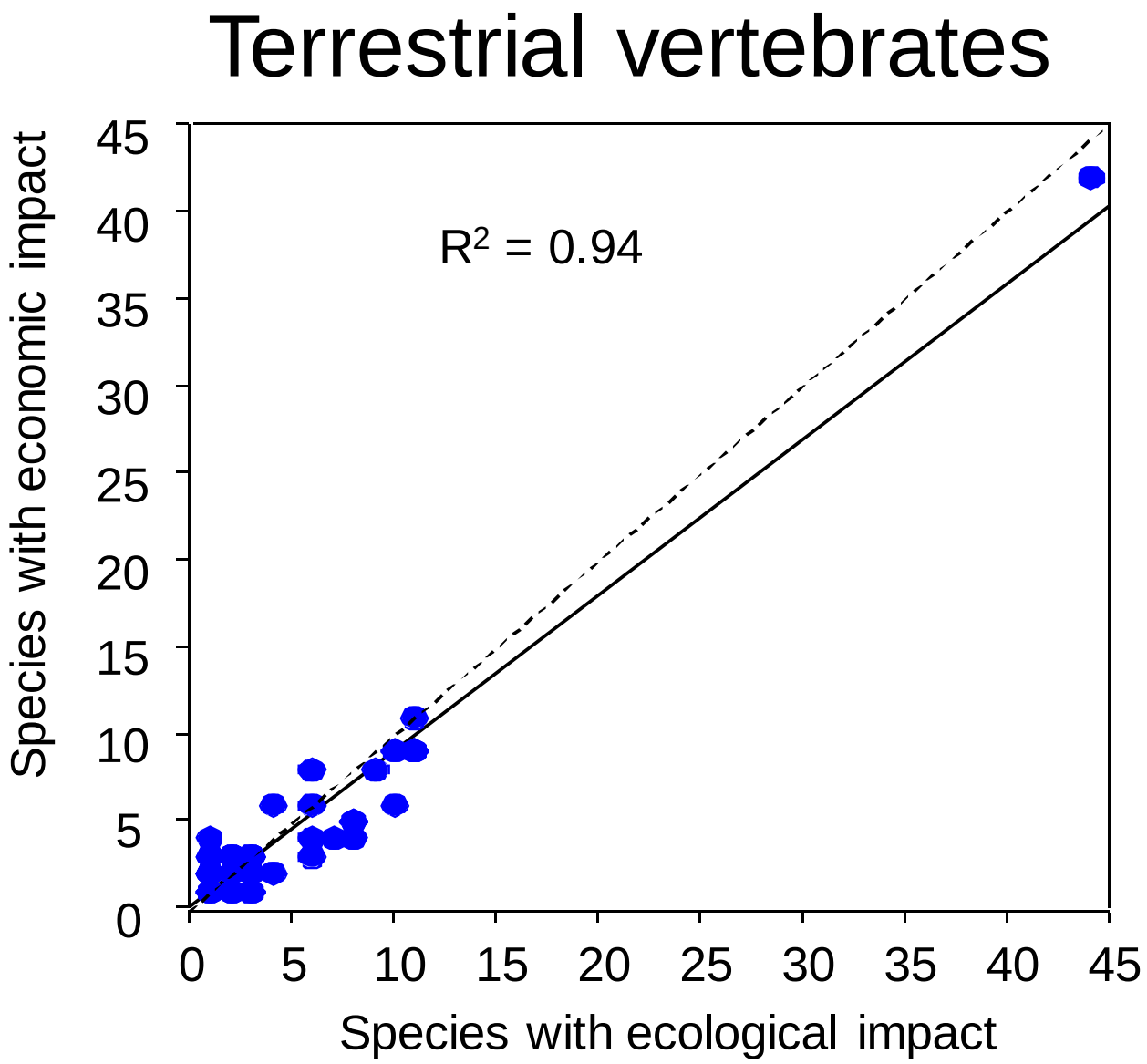

Handbook of Alien Species in Europe

Ecological and economic impact by taxa

	Ecological (%)	Economic (%)
Terrestrial plants	326 (5)	315 (5)
Terrestrial invertebrates	342 (14)	601 (24)
Terrestrial vertebrates	109 (30)	138 (38)
Aquatic inland	145 (30)	117 (24)
Marine	172 (16)	176 (16)

(Vilà et al. Front. Ecol. Env.,2010)

Ecological-economic relationship by region



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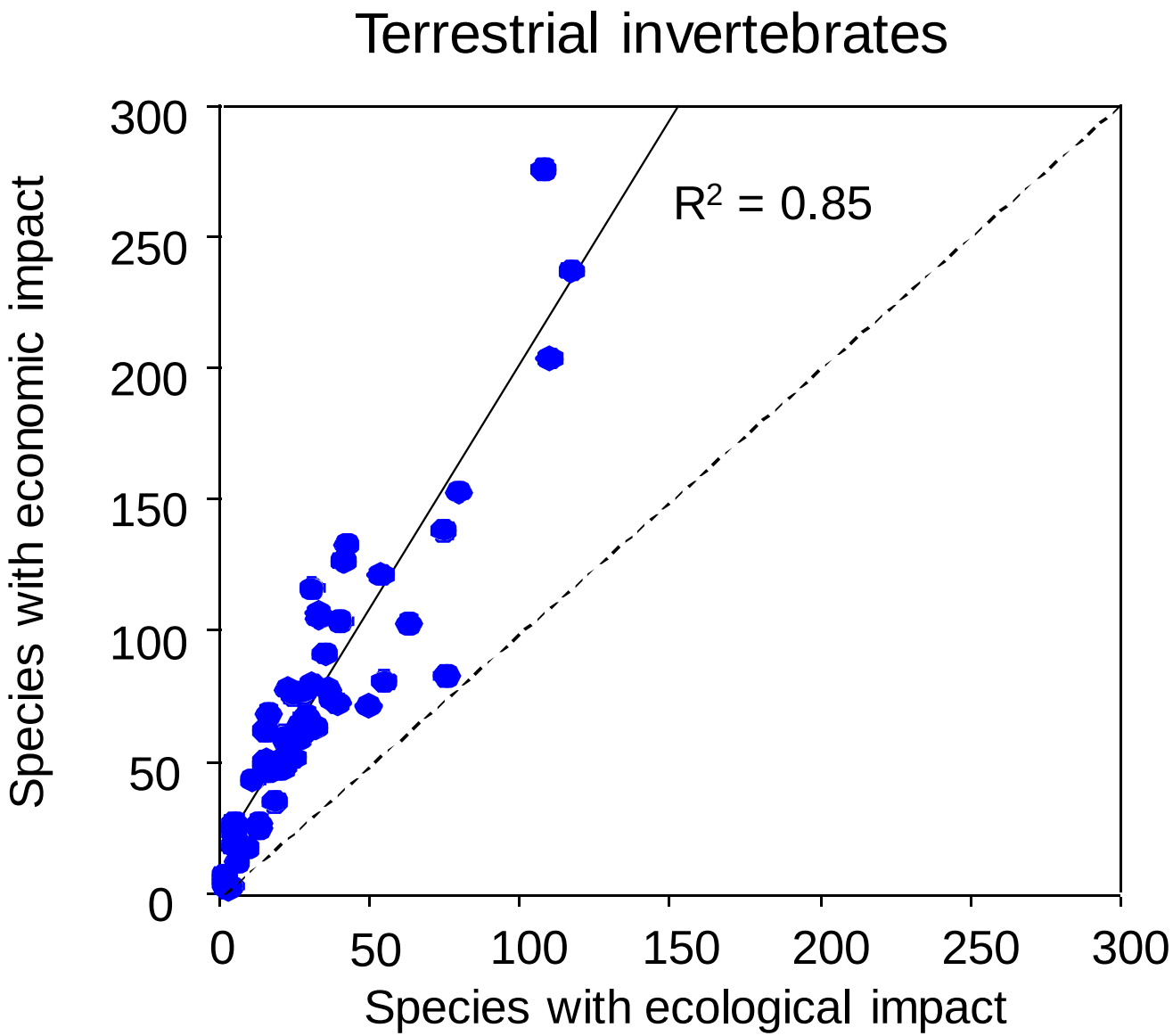


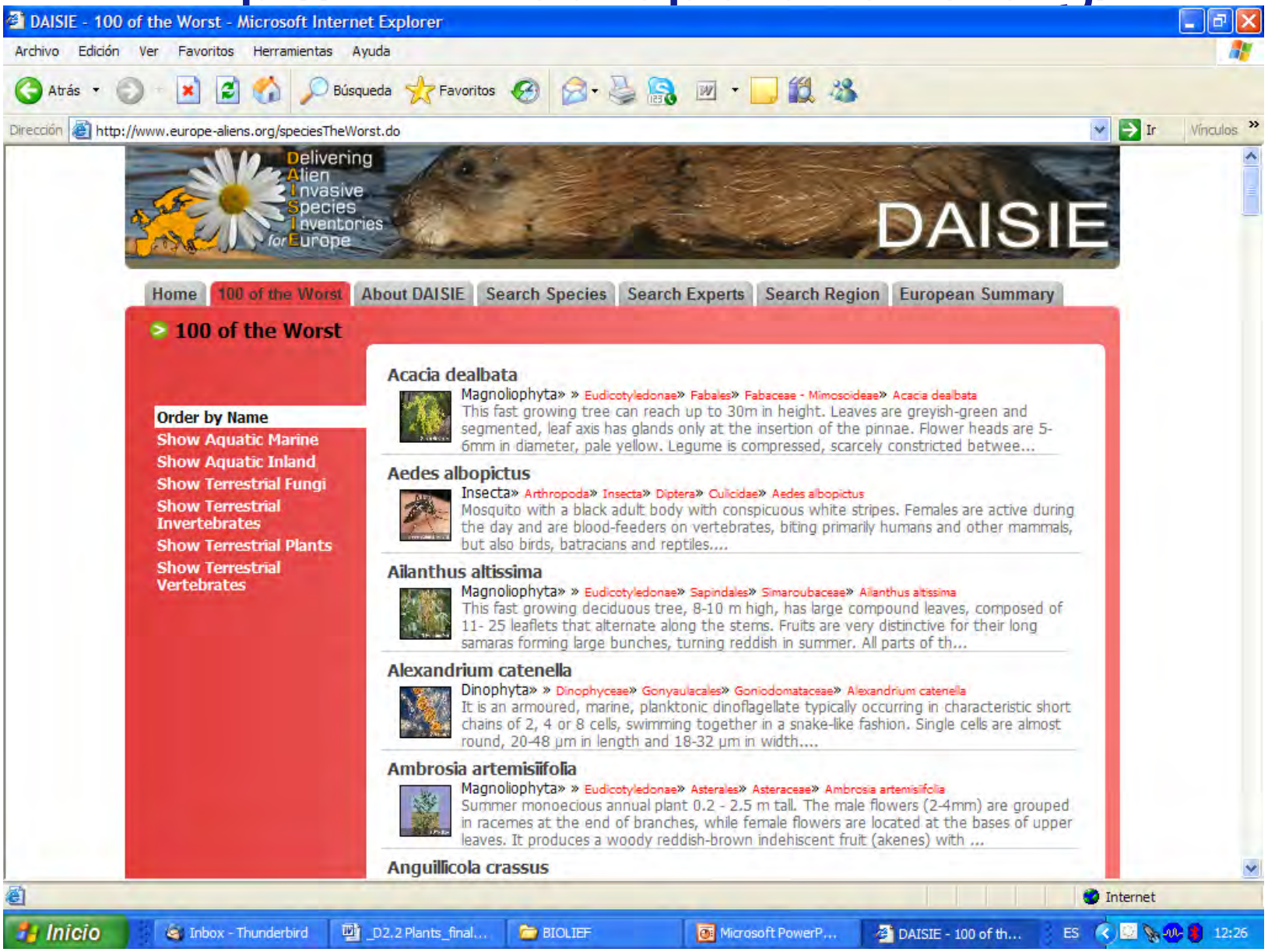
Top 3 with widespread impacts

Ondatra zibethicus
(71)

Nyctereutes procyonoides
(60)

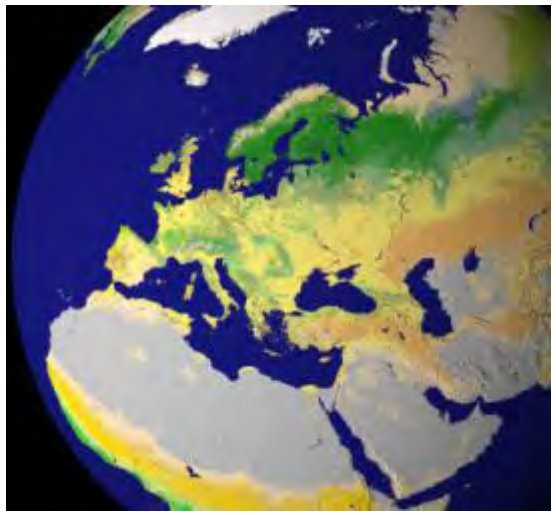
Rattus norvegicus
(51)

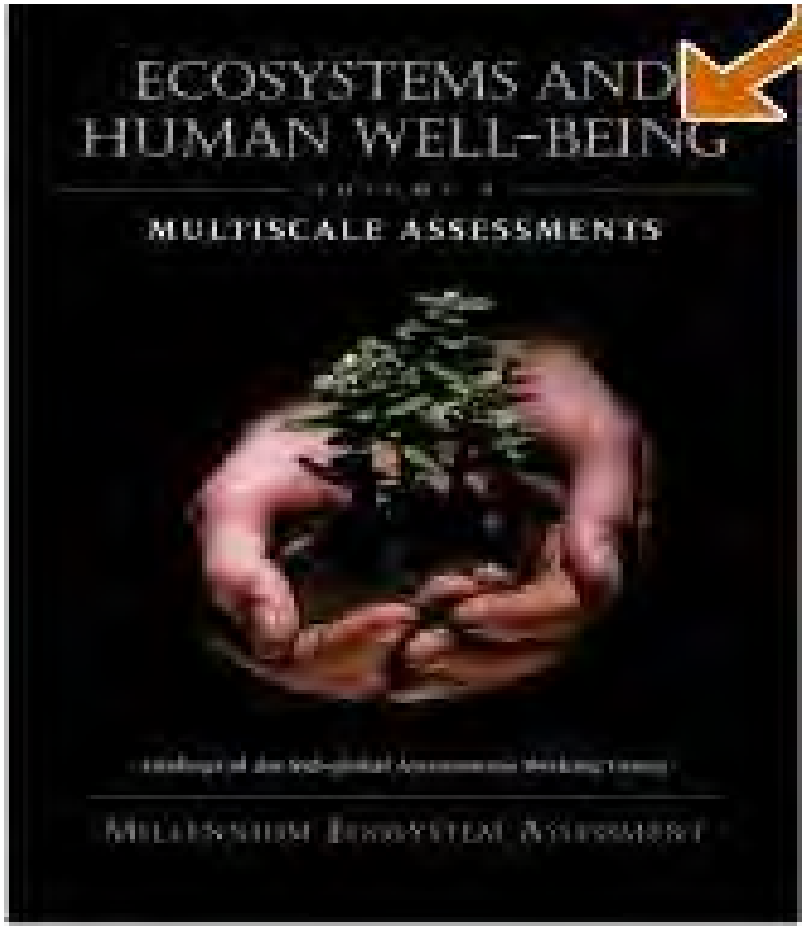
http://www.europe-aliens.org/



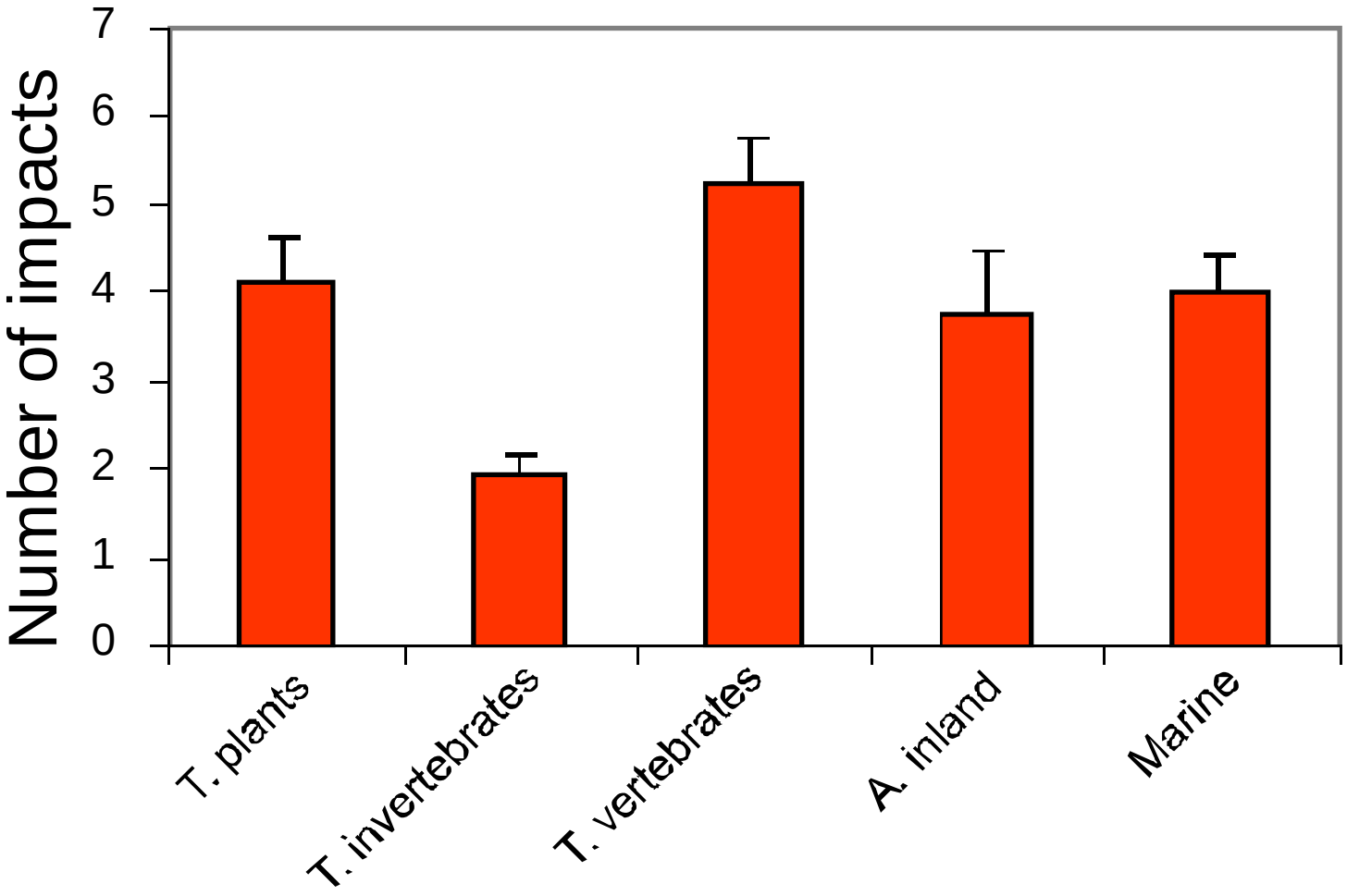
Ecosystem services

- 5 Supporting
- 3 provisioning
- 10 regulating
- 4 cultural





Variety of impacts



Vilà et al. (2010) *Frontiers in Ecology and the Environment*

Top plants with more impact types

Acacia dealbata

Oxalis pes-caprae

Carpobrotus spp.

Top vertebrates with more impact types

Myocastor coypus

Cervus nippon

Branta canadensis

Top freshwater with more impact types

Salvelinus fontinalis

Dreissena polymorpha

Procambarus clarkii

Top marine with more impact types

Balanus improvisus

Codium fragile

Undaria pinnatifida

Erradication/control

50 Mio €

(Andreu et al. 2009)

Infraestructure damage and restoration

Teredo navalis 75 Mio € (1993-2007)

(Leppäkoski et al. 2002)

Agricultural and forestry damages

Weed control in UK 256 Mio € (1983-1992)

(Williamson 1998)

Loss of commercial fisheries

Mnemiopsis leidyi (12 Mio €/ per year)

(Knowler 2005)

Human health

Ambrosia artemisiifolia
(20-50 Mio €/ per year)

Reinhardt
et al. 2003)

Chattonella spp
(7 Mio € in 2001)

(Hopkins 2002)

Desease vectors

Sociocultural impacts

- Education and inspiration
- Source of knowledgement
- Cultural heritage
- Aestetics
- Ecotourism

How much the impacts cost to Europe?

€ Eradication/control/containment

€ Infrastructure damage and restoration

€ Agricultural and forestry damages

€ Loss of commercial fisheries

€ Human health

€ (Research, consulting, prevention, monitoring)

10 billion €/yr (COM2008 789, EC, Brussels 2008)

Conclusions

- More than 10 % alien species are causing impacts
- Lack of impact can be confounded by research intensity
- Invaders cause multiple impacts to relevant ecosystem services and human well-being
- There is a positive relationship between ecological and economic impact
- Information on impacts/monetary costs is scarce and it is likely to be underestimated for
  - species-rich taxa
  - highly invaded regions
  - nontangible impacts.

Further questions

- Which plant species traits confer the highest impact and where?
- Are there thresholds for impact?
- Which impacts have the largest legacies?


Joyeux Noël et
Bonne Année!
Merci!