

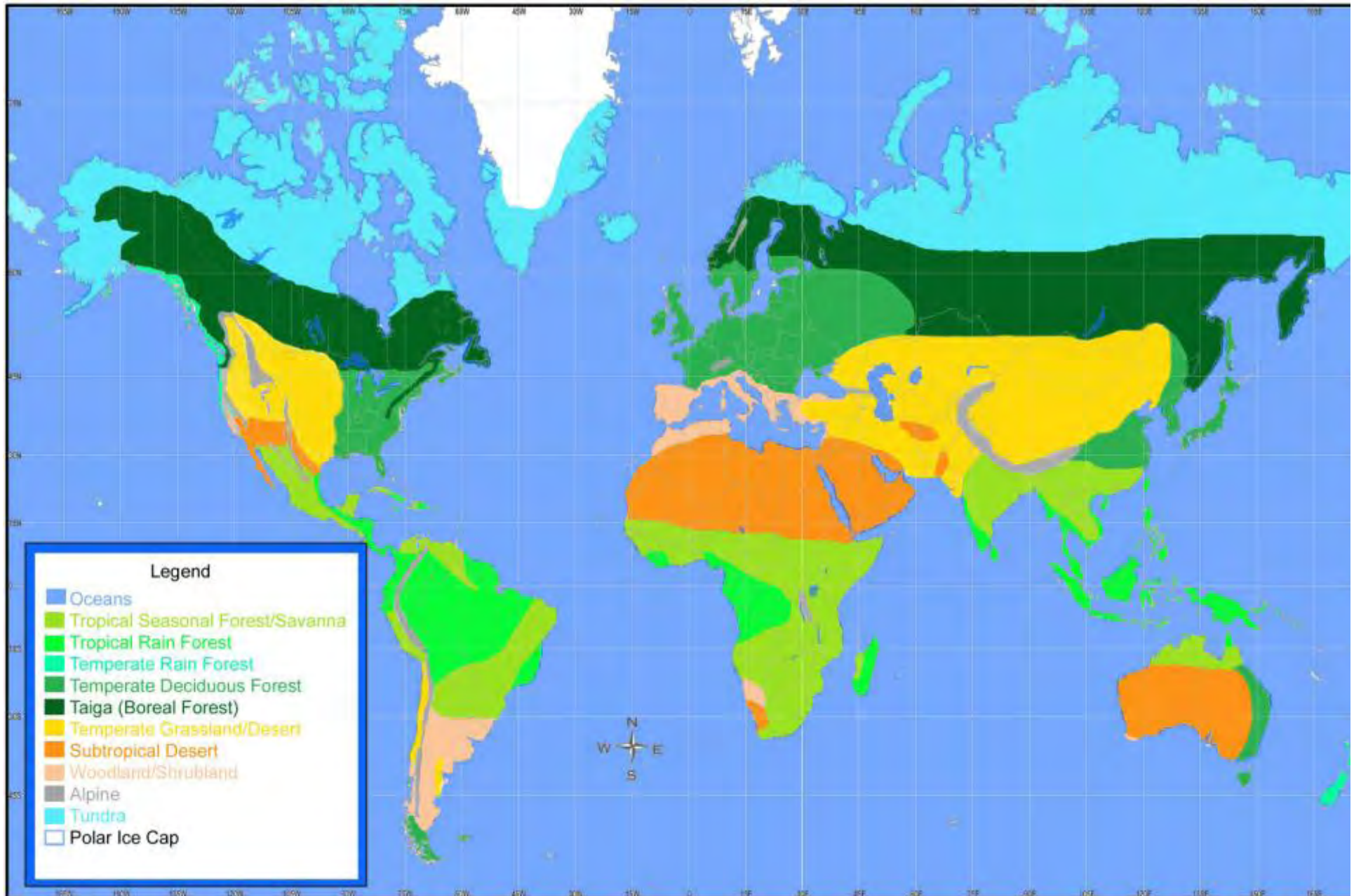
# Impacts of biological invasions

Montserrat Vilà

OT-Med Conference  
Marseille, December 17, 2012



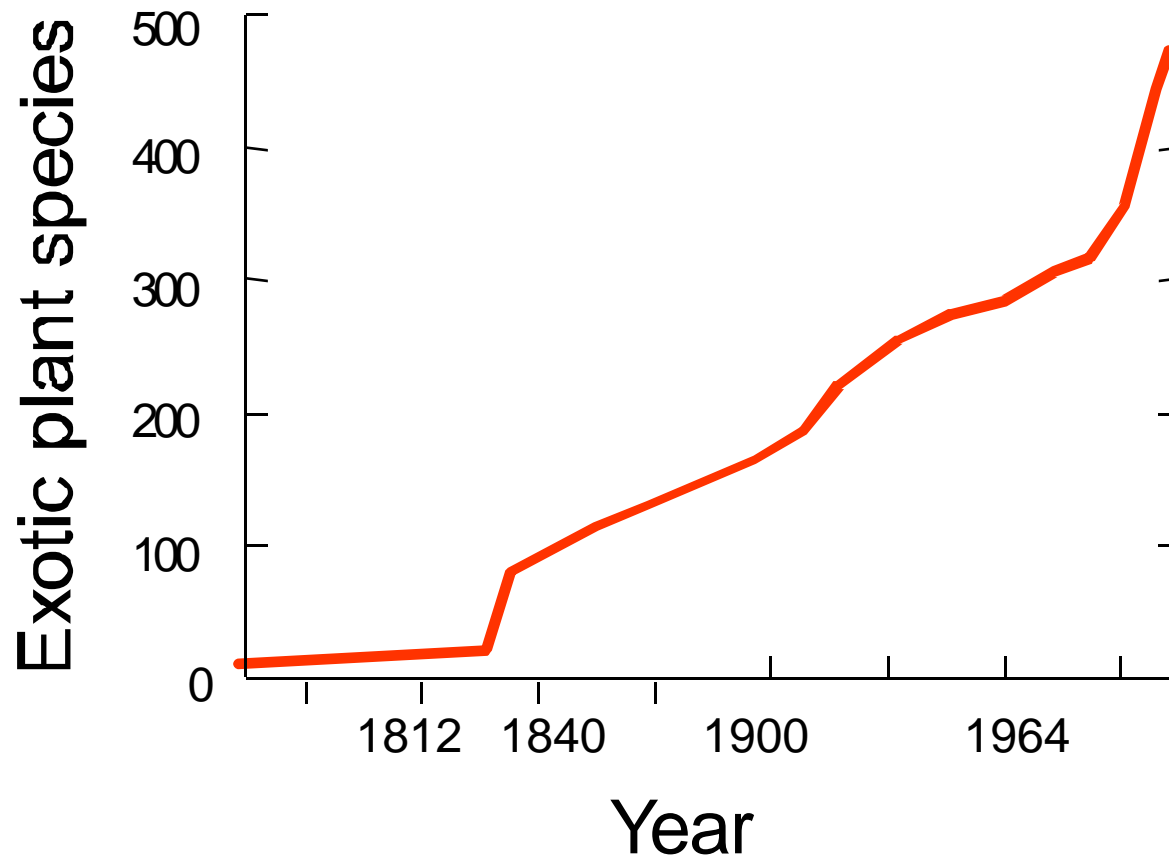




# Pathways of introduction

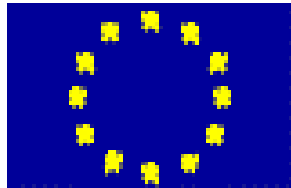




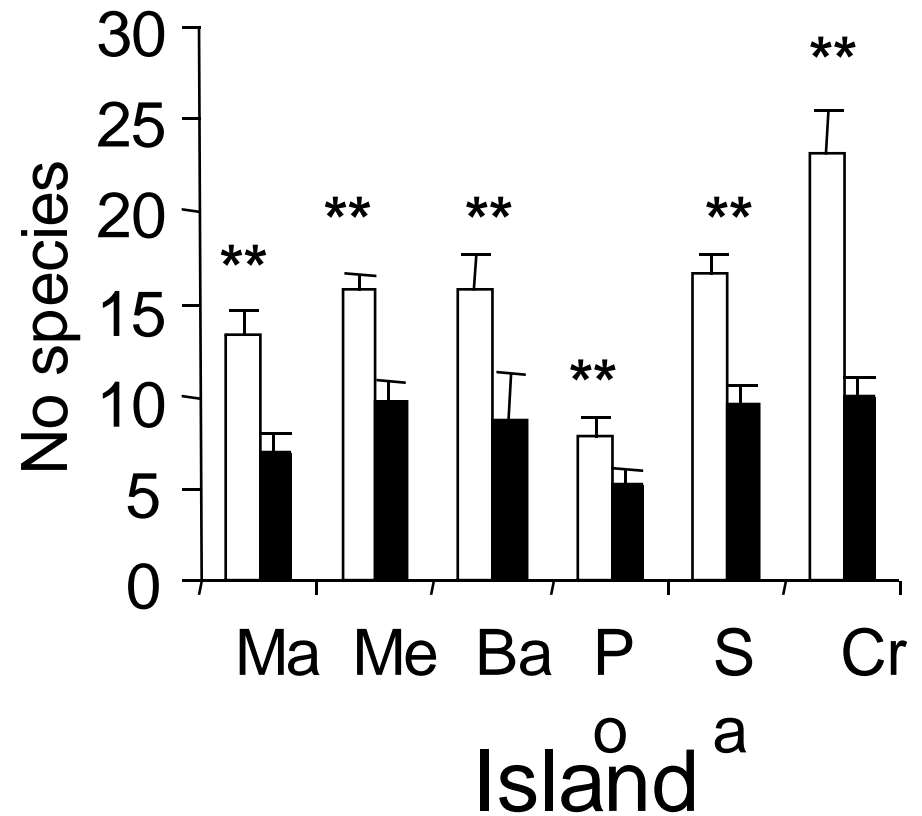
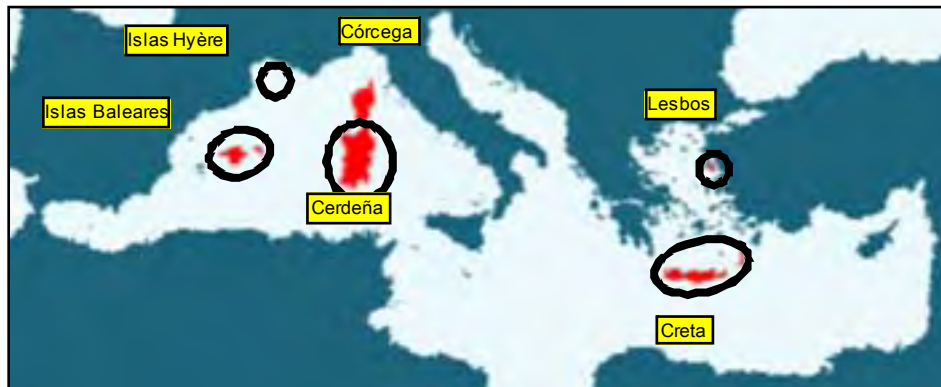


(Modified from Jeanmonod 1998)

# Decrease in diversity



EPIDEMIE



(Vilà et al. 2006)

# Disruption of trophic networks



*Dreissena polymorpha*



*Procambarus clarkii*



*Acacia spp.*



*Robinia pseudoacacia*



(Foto: Sanz\_Elorza et al 2004)

# Changes in ecosystem functioning



*Myrica faya*

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

**Total**

**5.5**

**23.5**

1) Global analysis of alien plant impacts

2) European assessment of alien species impacts

1) Global analysis of alien plant impacts

2) European assessment of alien species impacts

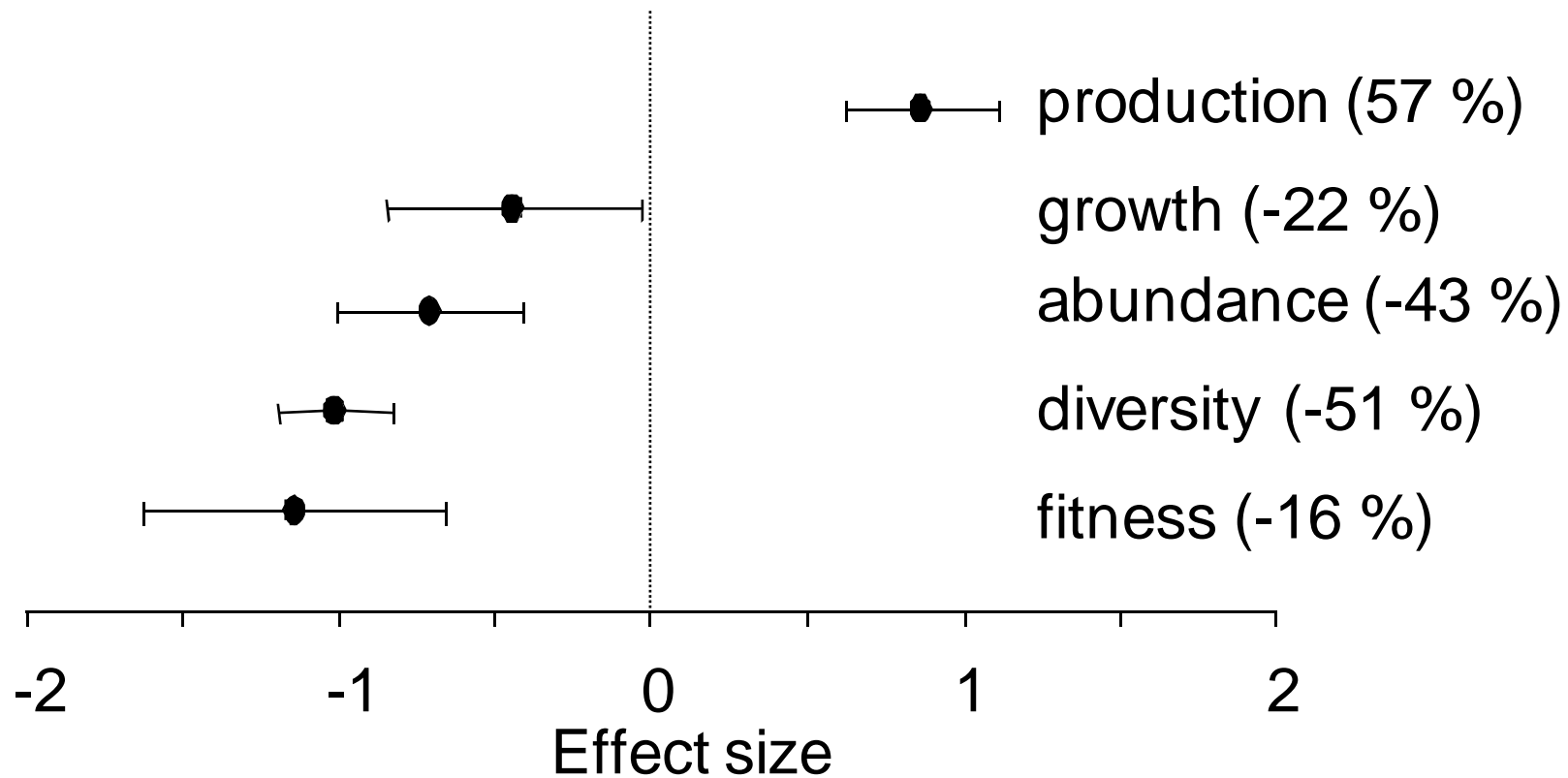
# Objectives

- Quantify the magnitude of their effects on species, communities and ecosystems.
- Compare differences between N-fixing and non N-fixing species.

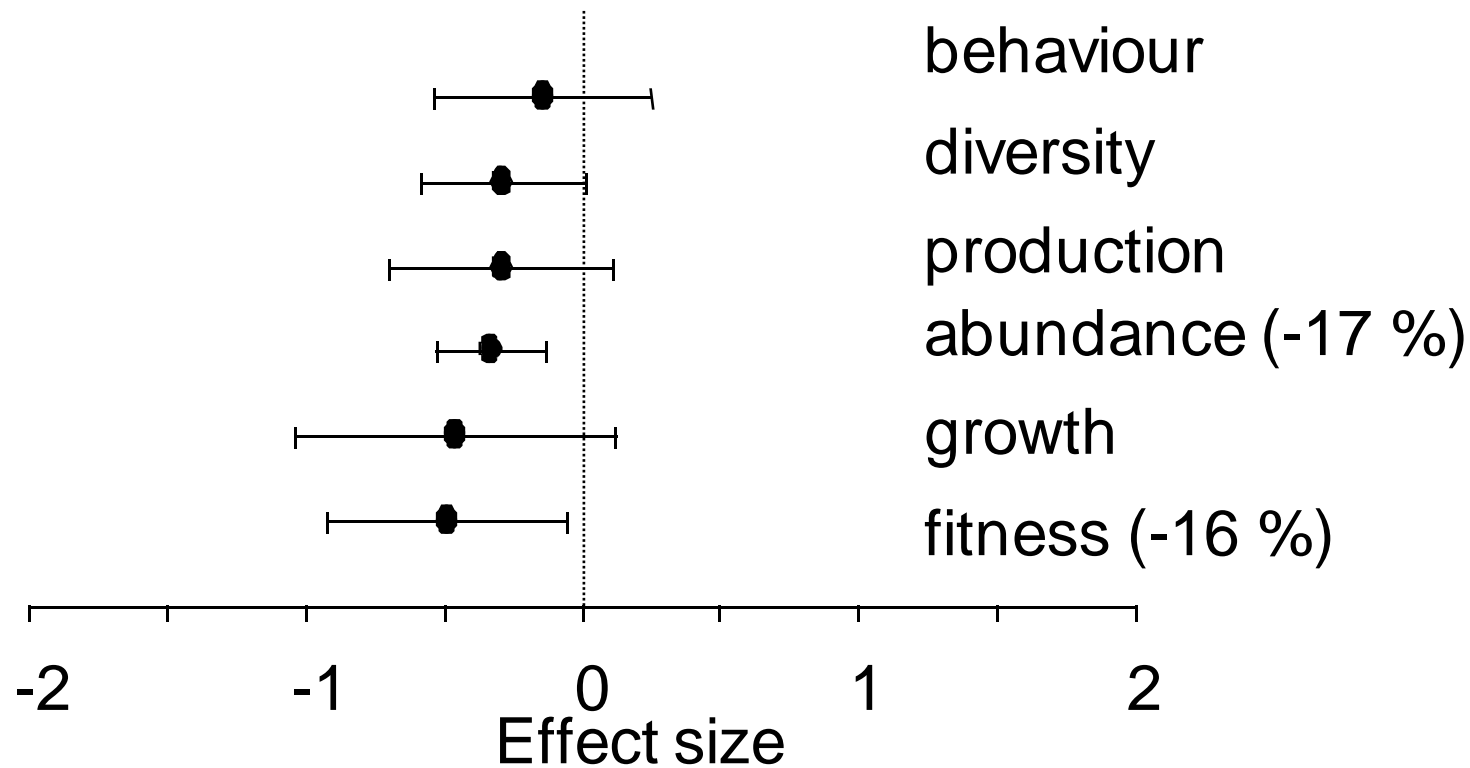
# Methods

- 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

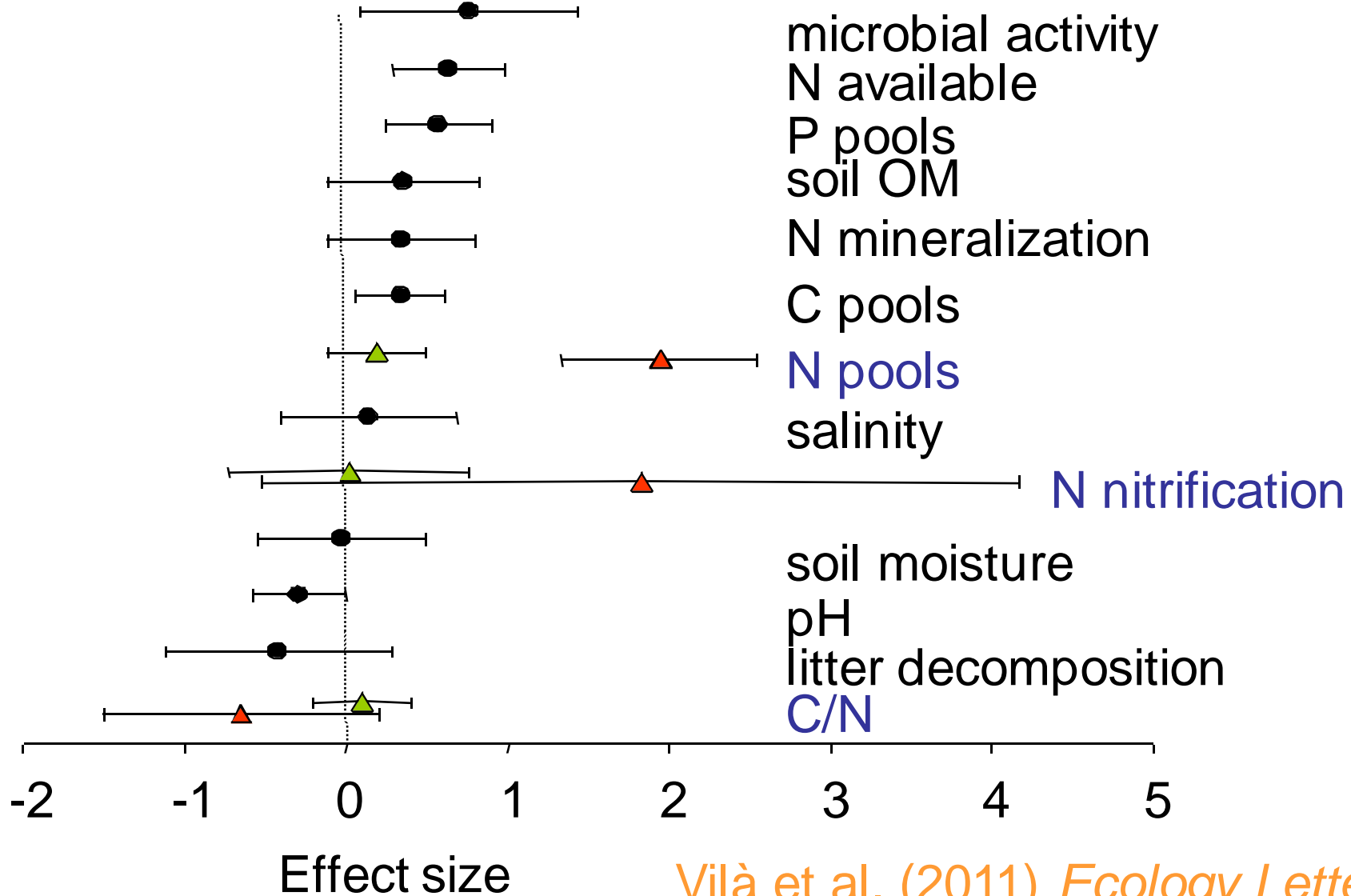


# Effects on animals





# Effects on ecosystems

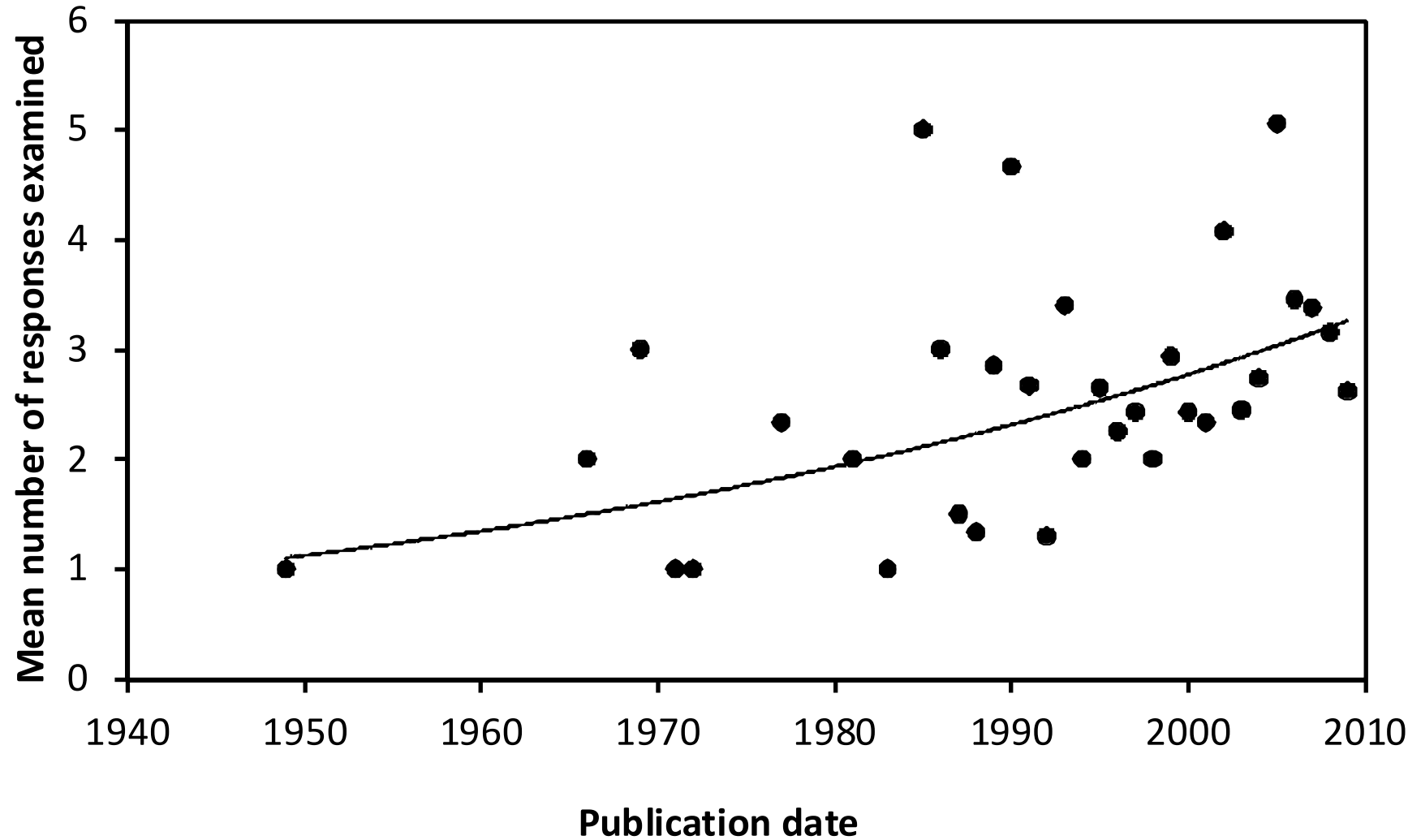


Vilà et al. (2011) *Ecology Letters*

# Conclusions

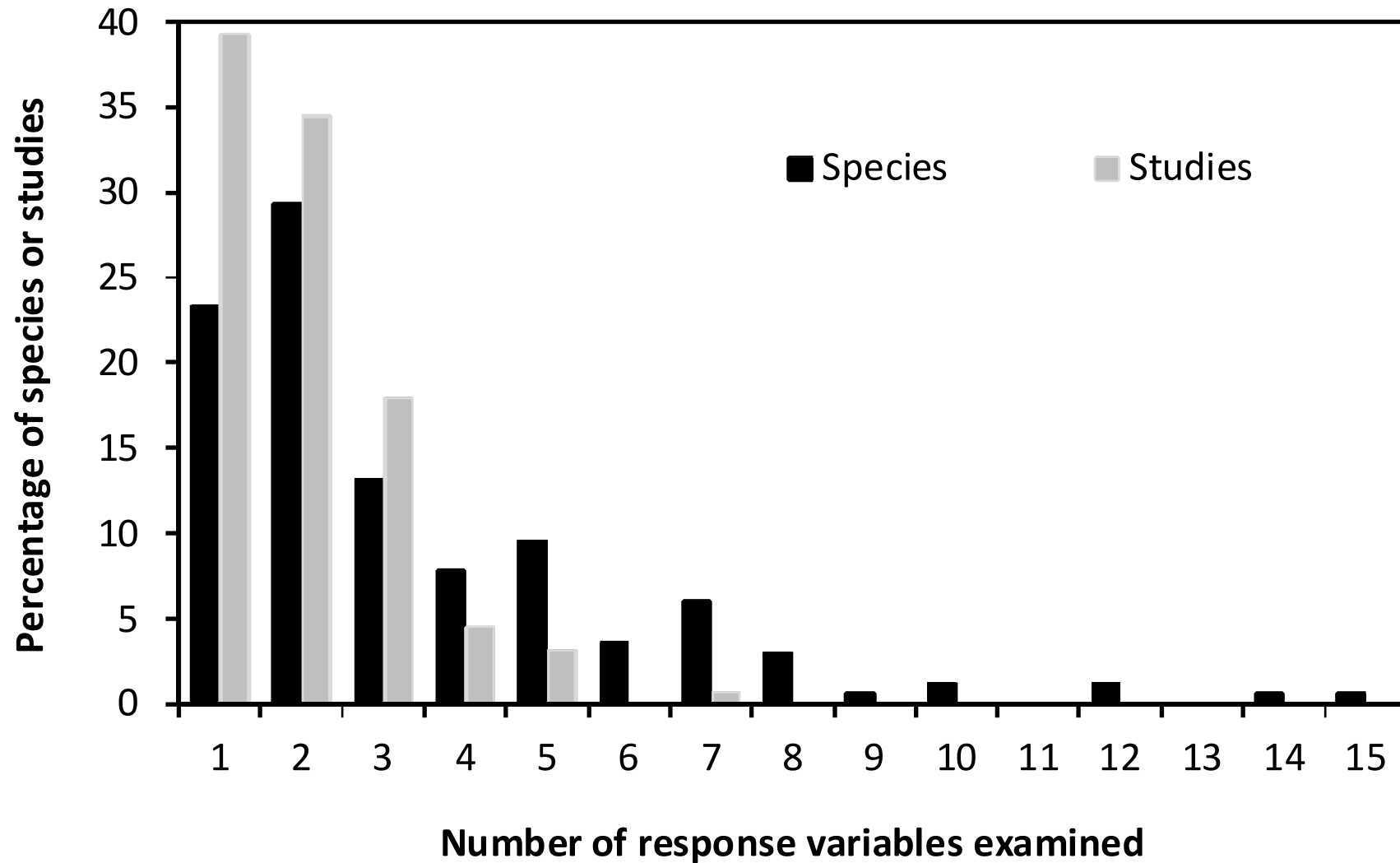
- Magnitude and direction varied between and within impact types (5 orders magnitude).
- Consistent change in 13 out of 24 impact types.
- Largest on plant production, diversity and N availability.
- N-fixing species impact on N cycling.

# Number of impacts through time



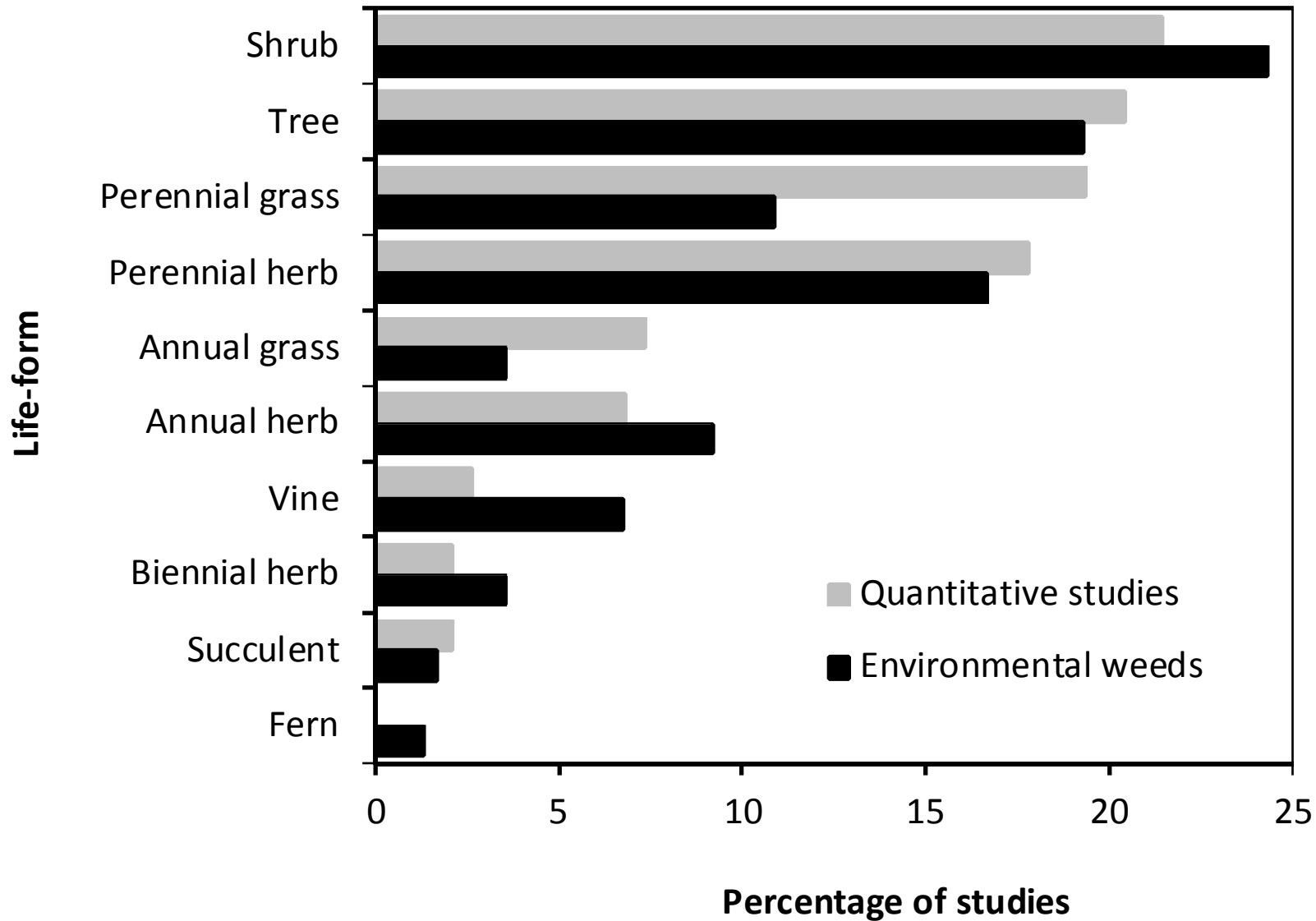
Hulme et al. Trends in Ecology & Evolution (in press)

# Number of impacts

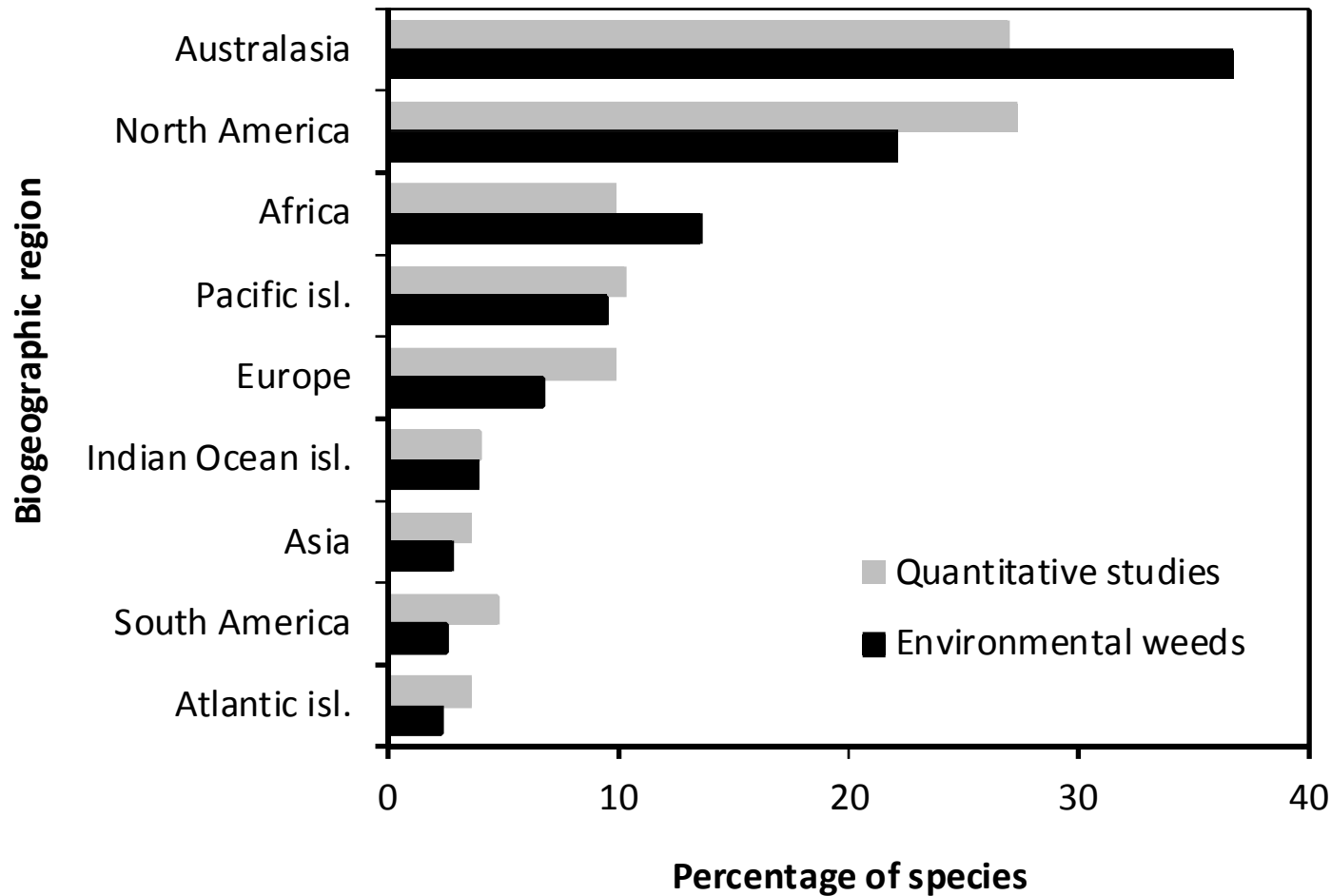


Hulme et al. Trends in Ecology & Evolution (in press)

# Live-form bias



# Geographic bias



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

1) Global analysis of alien plant impacts

2) European assessment of alien species impacts

DAISIE - 100 of the Worst - Microsoft Internet Explorer

Arquivo Edição Ver Favoritos Ferramentas Ajuda

Abra + Busqueda Favoritos

http://www.europe-allens.org/100oftheWorst.do



Home 100 of the Worst 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**

Magnoliophyta > Eudicotyledones > Fabales > Fabaceae > Mimosales > **Acacia dealbata**

This fast growing tree can reach up to 30m in height. Leaves are greyish-green and segmented. Leaf axils has glands only at the insertion of the petiole. Flower heads are 5-6cm in diameter, pale yellow. Legume is compressed, scarcely constricted between...

**Aedes albopictus**

Insecta > Arthropoda > Insecta > Diptera > Culicidae > **Aedes albopictus**

Mosquito with a black adult body with conspicuous white stripes. Females are active during the day and are blood-feeders on vertebrates, being primarily humans and other mammals, but also birds, bats and reptiles....

**Alanthus altissima**

Magnoliophyta > Eudicotyledones > Asterales > Asteraceae > **Alanthus altissima**

**Alexandrium**

Dictyostelium > Dictyostelium > **Alexandrium**

**Ambrosia artemisiifolia**

Magnoliophyta > Eudicotyledones > Asterales > Asteraceae > **Ambrosia artemisiifolia**

**Anguillula**

Phylum: Nematoda > Class: Secernentea > Order: Rhabditida > Superfamily: Anguillulidae > **Anguillula**

**daisie**  
experts registry

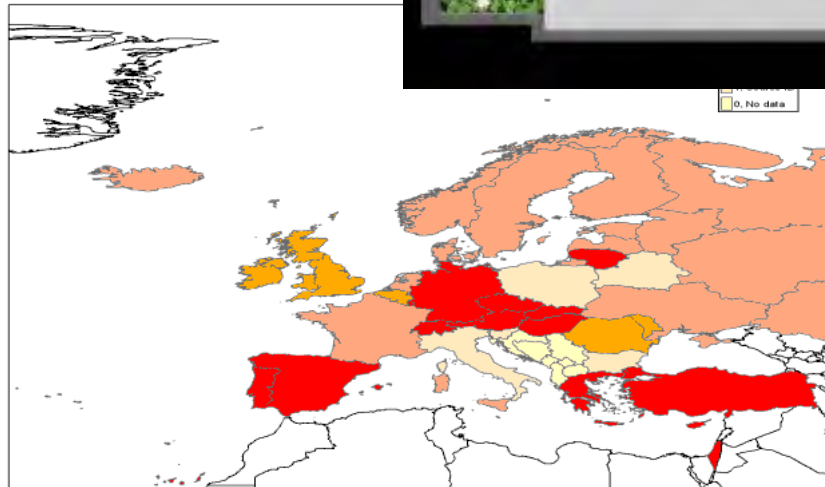
Experts registration my profile Search expertise

alphabetically by country by taxon

**Expert Profile** Taxa

First Name Philip  
Last Name Hulme  
Title Dr  
Institution Natural Environment Research Council  
Address Centre for Ecology & Hydrology  
Bangor  
Lancaster Lane  
LA1 4AQ  
Country United Kingdom  
E-Mail phil@ceh.ac.uk  
URL http://bangor.ceh.ac.uk/infocentre/people/people.php?user=hulme

- 1: Data source identified
- 2: Data acquired and a deadline for submission agreed
- 3: A provisional data set submitted
- 4: Final species list submitted





# Ecological and economic impact by taxa

Ecological (%) Economic (%)

---

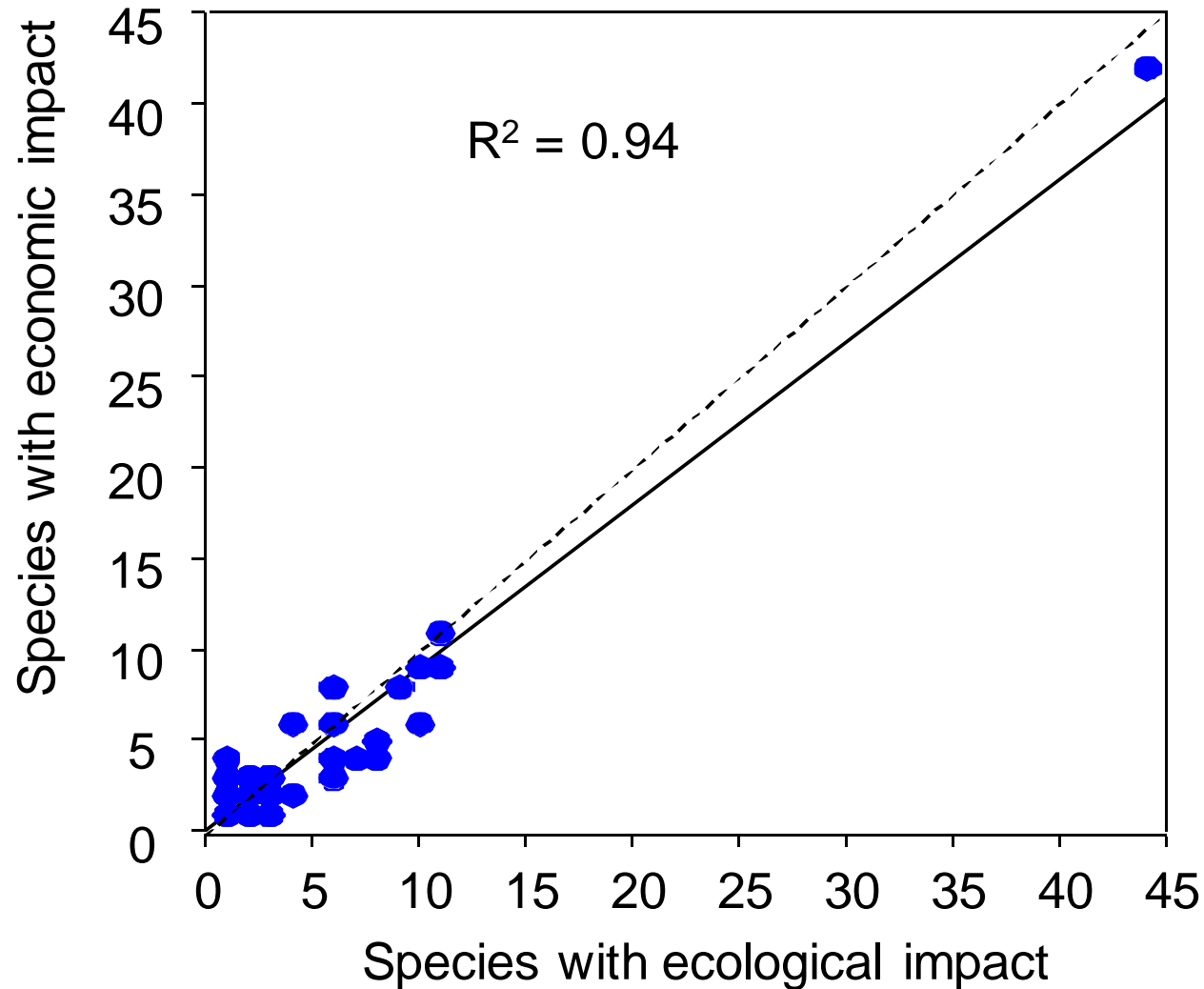
Terrestrial plants	326 (5)	315 (5)
Terrestrial invertebrates	342 (14)	601 (24)
Terrestrial vertebrates	109 (30)	138 (38)
Aquatic inland	145 (30)	117 (24)
Marine	172 (16)	176 (16)

---

(Vilà et al. Front. Ecol. Env.,2010)

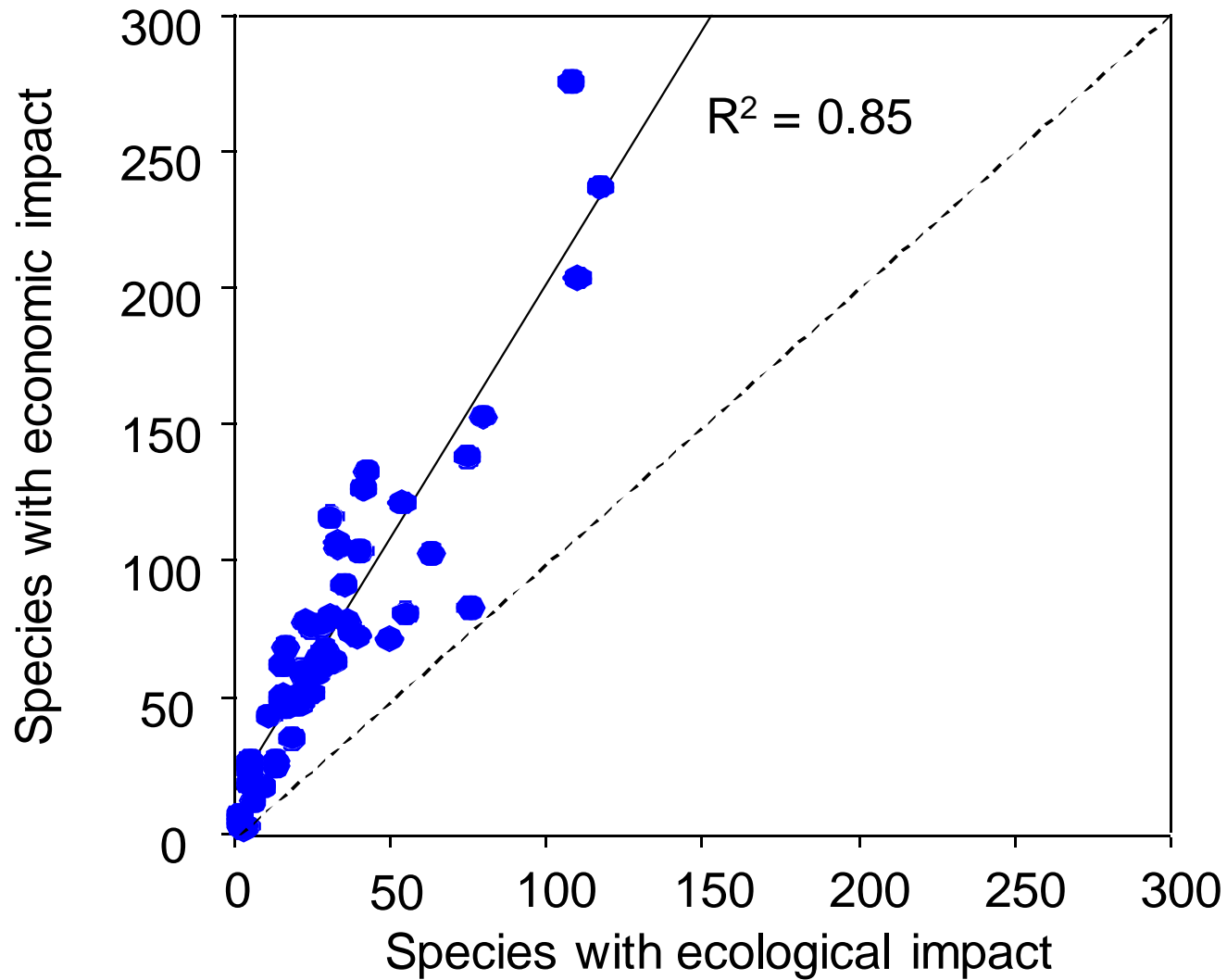
# Ecological-economic relationship by region

## Terrestrial vertebrates



# Ecological-economic relationship by region

## Terrestrial invertebrates



# Top 3 with widespread impacts



*Ondatra zibethicus*  
(71)



*Nyctereutes procyonoides*  
(60)



*Rattus norvegicus*  
(51)


# http://www.europe-alien.org/

DAISIE - 100 of the Worst - Microsoft Internet Explorer

Archivo Edición Ver Favoritos Herramientas Ayuda

Atrás Búsqueda Favoritos Ir Vínculos

Dirección http://www.europe-alien.org/speciesTheWorst.do



Home 100 of the Worst 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**  
Magnoliophyta » Eudicotyledonae » Fabales » Fabaceae » Mimosoideae » *Acacia dealbata*  
This fast growing tree can reach up to 30m in height. Leaves are greyish-green and segmented, leaf axis has glands only at the insertion of the pinnae. Flower heads are 5-6mm in diameter, pale yellow. Legume is compressed, scarcely constricted between...

**Aedes albopictus**  
Insecta » Arthropoda » Insecta » Diptera » Culicidae » *Aedes albopictus*  
Mosquito with a black adult body with conspicuous white stripes. Females are active during the day and are blood-feeders on vertebrates, biting primarily humans and other mammals, but also birds, batracians and reptiles....

**Ailanthus altissima**  
Magnoliophyta » Eudicotyledonae » Sapindales » Simaroubaceae » *Ailanthus altissima*  
This fast growing deciduous tree, 8-10 m high, has large compound leaves, composed of 11- 25 leaflets that alternate along the stems. Fruits are very distinctive for their long samaras forming large bunches, turning reddish in summer. All parts of th...

**Alexandrium catenella**  
Dinophyta » Dinophyceae » Gonyaulacales » Goniodomataceae » *Alexandrium catenella*  
It is an armoured, marine, planktonic dinoflagellate typically occurring in characteristic short chains of 2, 4 or 8 cells, swimming together in a snake-like fashion. Single cells are almost round, 20-48 µm in length and 18-32 µm in width....

**Ambrosia artemisiifolia**  
Magnoliophyta » Eudicotyledonae » Asterales » Asteraceae » *Ambrosia artemisiifolia*  
Summer monoecious annual plant 0.2 - 2.5 m tall. The male flowers (2-4mm) are grouped in racemes at the end of branches, while female flowers are located at the bases of upper leaves. It produces a woody reddish-brown indehiscent fruit (akenes) with ...

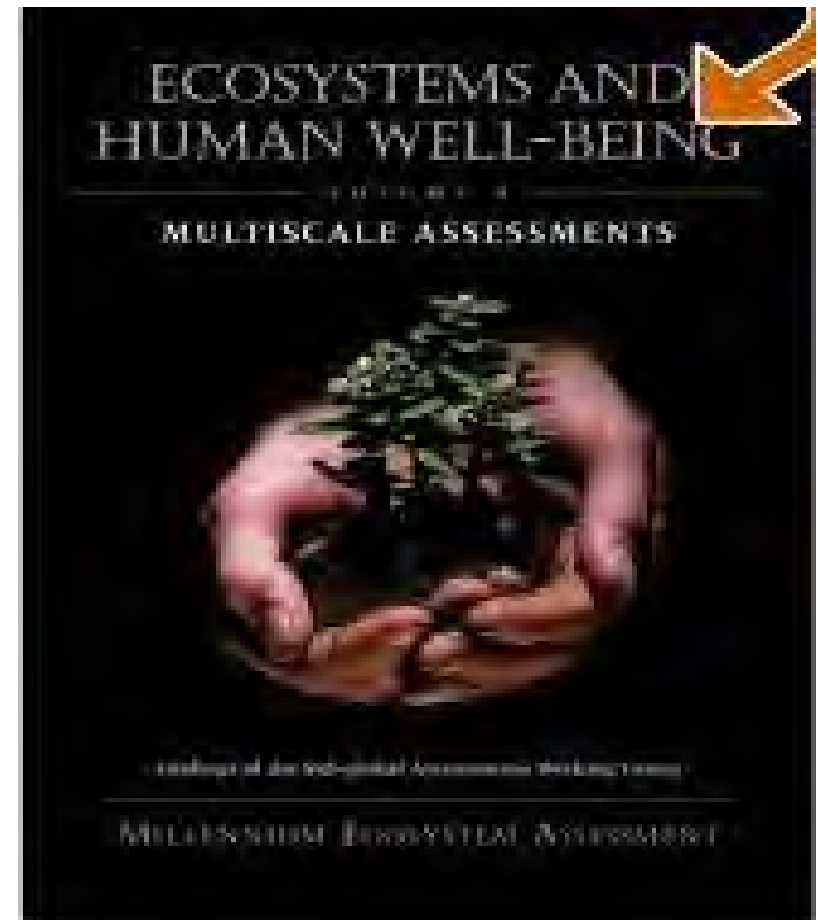
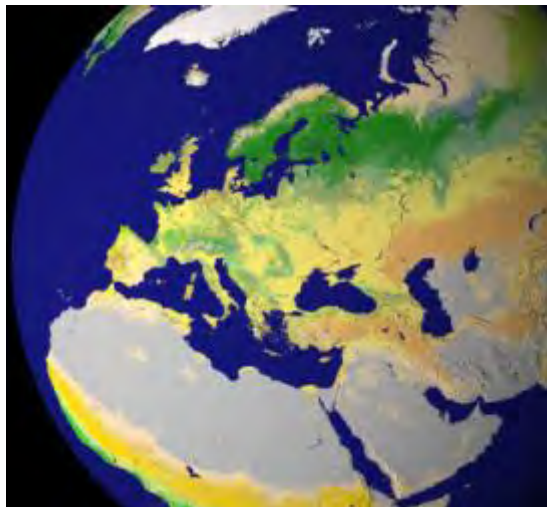
**Anguillicola crassus**

Internet

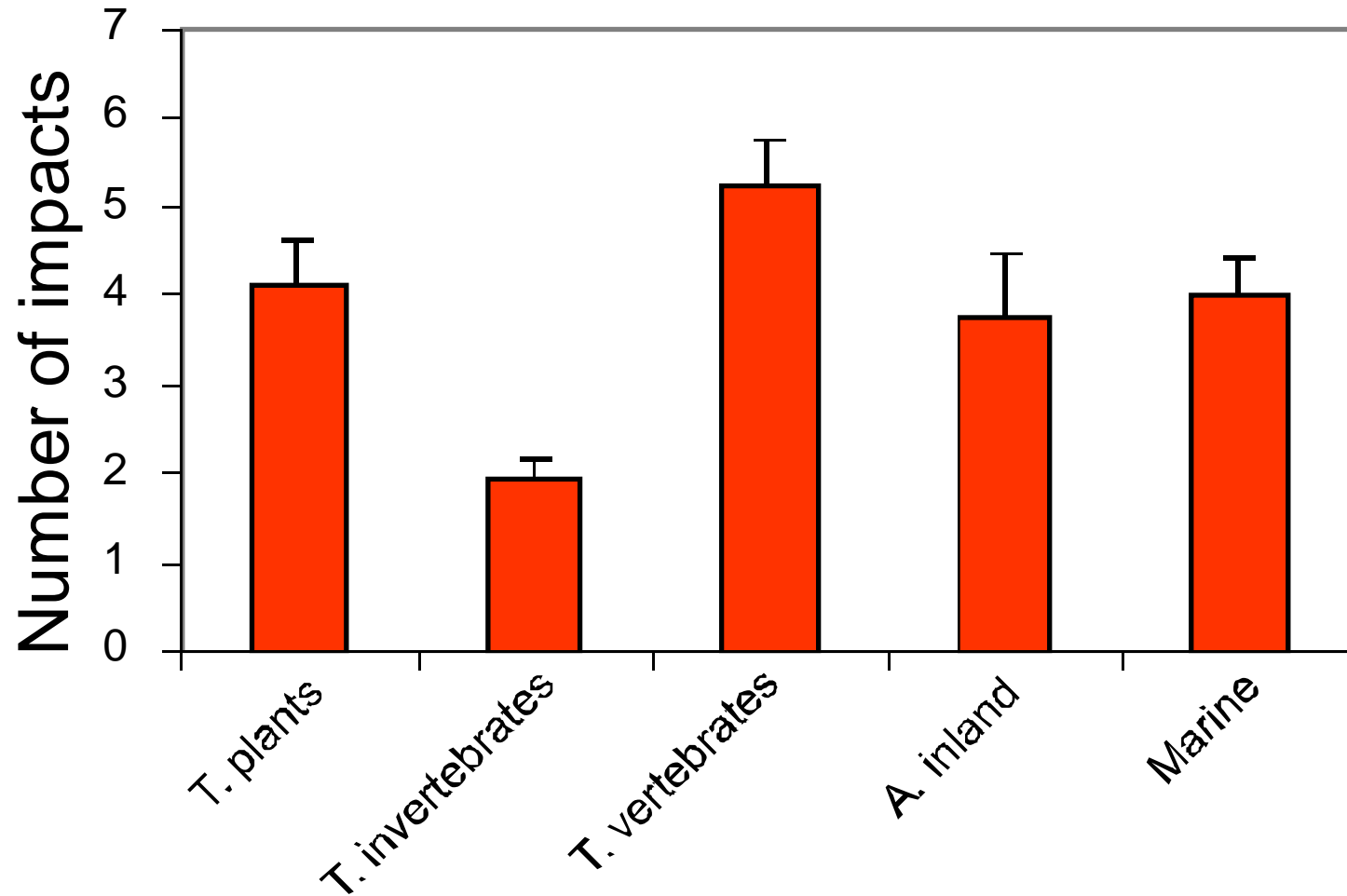
Inicio Inbox - Thunderbird \_D2.2 Plants\_final... BIOLIEF Microsoft PowerP... DAISIE - 100 of th... ES 12:26

# Ecosystem services

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



# Variety of impacts



# 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*

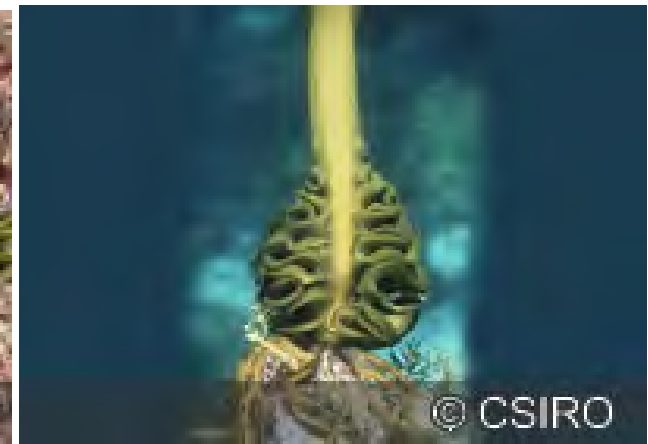
# Top marine with more impact types



*Balanus improvisus*



*Codium fragile*



*Undaria pinnatifida*

# Erradication/control

50 Mio €



(Andreu et al. 2009)

# Infraestructure damage and restoration

*Teredo navalis* 75 Mio € (1993-2007)



© Marco Faasse

(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)

© Larry Allain

*Chattonella* spp  
(7 Mio € in 2001)



© Bay Paul Center

(Hopkins 2002)



# Desease vectors



# Sociocultural impacts

- Education and inspiration
- Source of knowledge
- Cultural heritage
- Aesthetics
- 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!