

Plant invasions in spotlight

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Some characteristics of invasive species

Invasive species had significantly higher performance and dispersal traits than non-invasive

- photosynthetic rate and transpiration
- nitrogen and water use efficiency
- shoot and leaf-area allocation (higher SLA)
- growth rate (bigger size, early maturation)
- seed size and seed number
- self-compatibility
- vegetative and generative spread
- long seed dispersal in time and space
- allelopathy

These traits enable plants to

- Establish in various environment
- Rapid response to changing environment
- outcompete other species

Some characteristics of invasive species

- However, comparing invasive and native species invasive elsewhere no differences were found in their traits
- Why alien species are often more successful in the new habitats than in their native area?
 - Empty niches (e.g. liana species in Central Europe)
 - Enemy release hypothesis

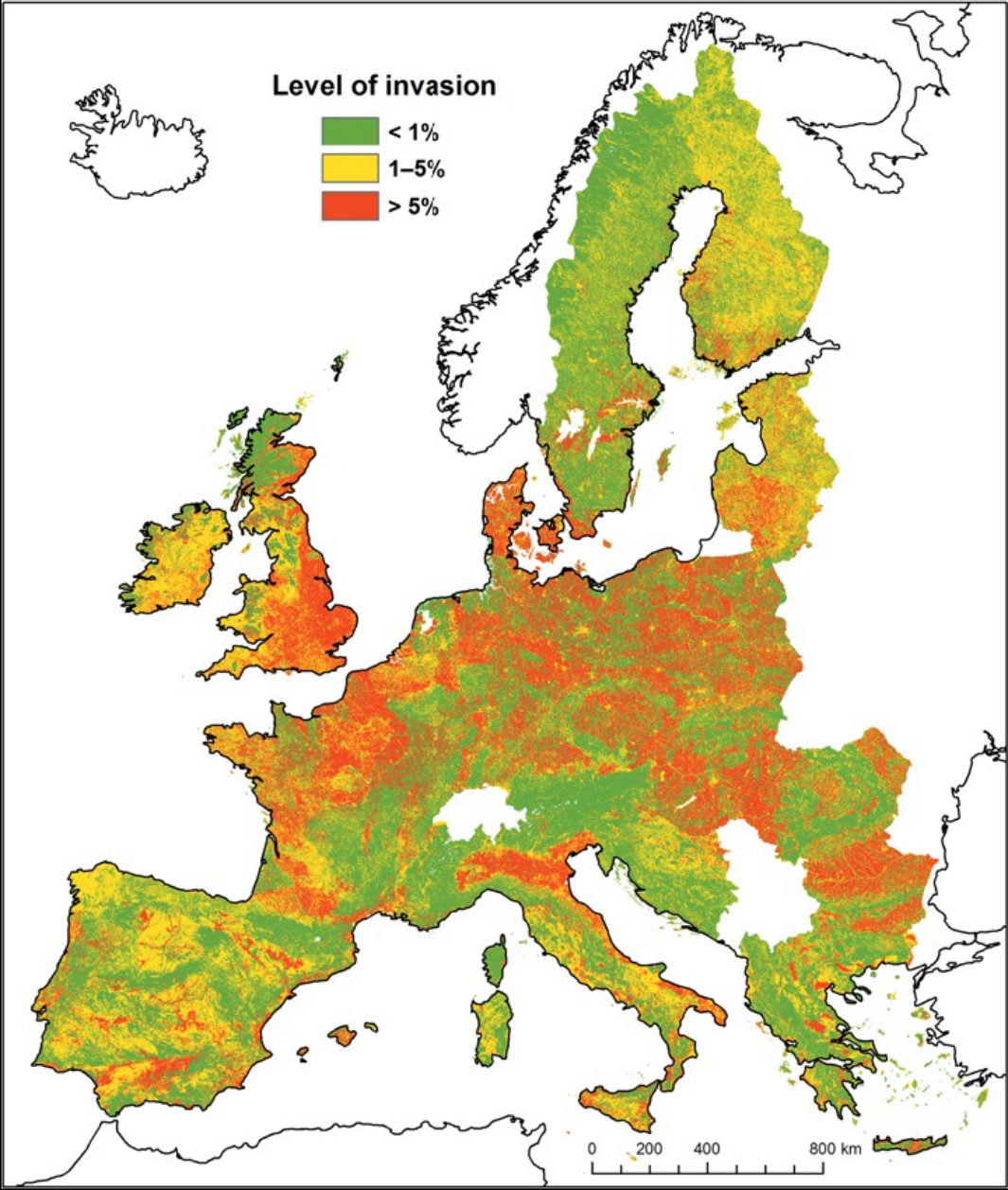
• Some further characteristic of invaders based on the above-mentioned statement

- Absence of co-evolved species
- faraway donor area (higher probability of phylogenetically distant taxa which use different niches)
- Wide and heterogeneous native range

Invasibility of ecosystems

- High propagule pressure (e.g. historical reasons)
 - Fluctuating environment, disturbance
 - Islands
 - Diversity, productivity – contradictory results
 - Even so there are some biomes and habitat types with high (steppes, savannas, Mediterranean veg. types, arable grasslands, wetlands), some others with low (tropical rain forest, tayga, tundra, peat bogs, alpine grasslands) invasion risk
 - Human population density
-
- Based on the characteristic of the invaders and the invasibility of habitats, it is possible to create systems to forecast the invasion risk of particular species

Invasibility of ecosystems



Chytry et al. 2009

Evaluation of invasion risk

European and Mediterranean Plant
Protection Organization
(EPPO) prioritization process (EPP)
(<https://www.eppo.int>)

Main considerations

- biogeography
- distribution
- invasiveness elsewhere
- potential impacts
- Management efficiency

11 questions

Output:

3 categories

- (1)Minor Concern, (2)Observation list,
(3)Invasive

Australian Weed Risk
Assessment (A-WRA) system
(
http://www.agriculture.gov.au/biosecurity/risk-analysis/reviews/weeds/system/weed_risk_assessment
)

Main considerations

- Cultivation
- Climate and distribution
- Weed elsewhere
- Undesirable traits
- Plant type
- Reproduction
- Dispersal mechanisms
- Persistence attributes

49 questions

Output:

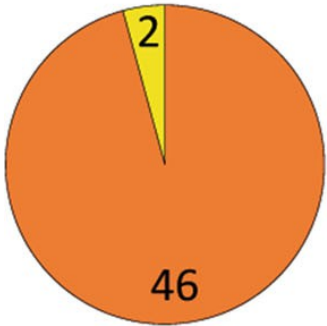
3 categories

- (1)Accept, (2)Evaluate, (3)Reject

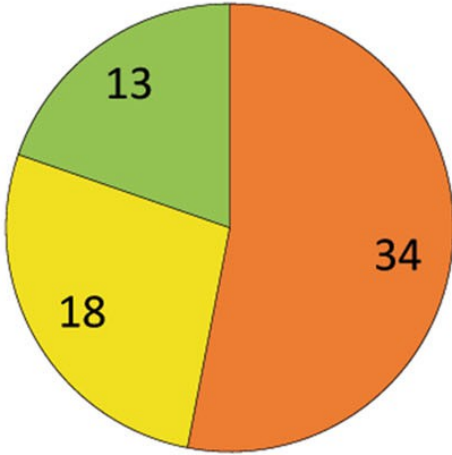
(1)Low, (2)Medium, (3)High invasion risk

Evaluation of invasion risk

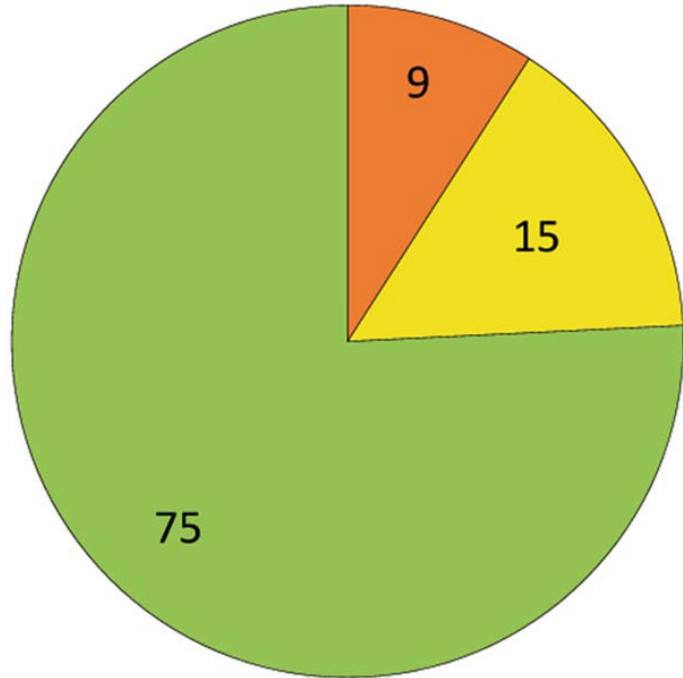
- A-WRA Rejected (89)
- A-WRA Evaluate further (35)
- A-WRA Accepted (88)



EPP Invasive (48)



EPP Obs list (65)



EPP Minor Concern (99)

Lazzaro et al. 2016

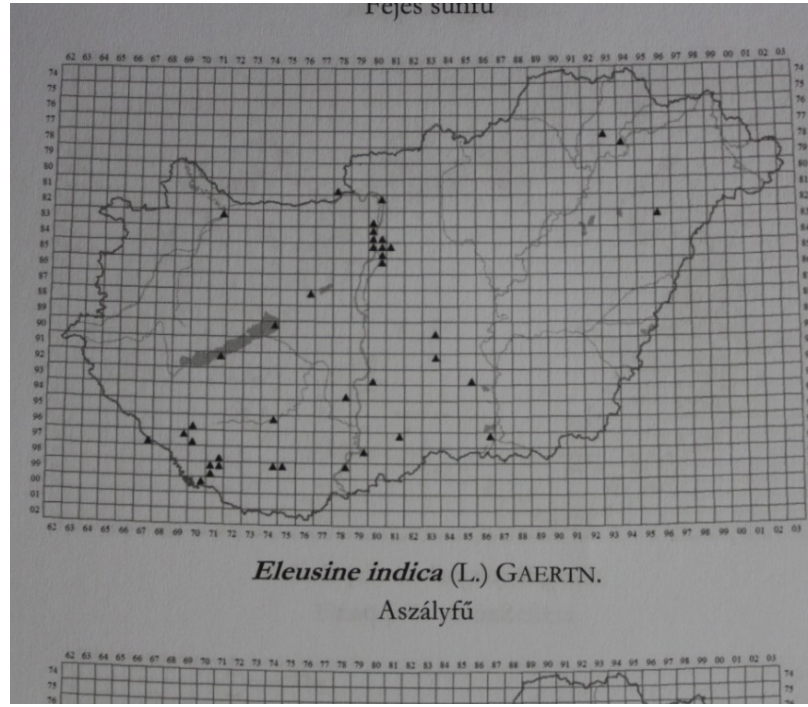
Comparison of output of the two evaluation methods based on 212 Mediterranean species

Application of A-WRA evaluation methods

• I performed the evaluation of 3 species recently appeared in Hungary

- *Eleusine indica*

- 1st record 1914
- Dangerous invasive
- A-WRA score: 17
- Rejected (=high invasion risk)



Application of these evaluation methods

- *Cycloloma ariplicifolia*

- First record in Hungary from 1995 by Karel Prach (Mandák & Prach 2001, Vidéki 2005)
- A-WRA score: 7
- Rejected (=high invasion risk); however if the A-WRA score ≤ 6 the system put species to Evaluate further (=medium invasion risk) category



- *Claytonia perfoliata*

- A-WRA score: 5
- Evaluate further (=medium invasion risk)
- However it is a host of Beet yellows virus



• **These risk assessments fit to our preconceptions**

Effects of invasions

Ecological effects:

- Altered ecosystem functioning, soil properties, loss of biodiversity, rarefaction of endangered species (42% of endangered species are threatened by aliens in USA (Pimentel et al. 2005) and 80% in South Africa (Armstrong 1995))
- Sometimes positive effects also occur (endangered ferns in pine plantations or endangered orchids in poplar plantations) or positive effects on pollinator communities

Ecosystem services:

- Water deficit, outcompete medicinal plants, increased risk of wild fire, loss of recreation places, wreck industrial tools, spread pathogens, allergies
- Used for building material, ornamental plants, provide shade, increase honey production, erosion control, food, accumulation of heavy metals (bioremediation)

Costs:

- Estimated annual costs associated with alien species in 2004, USA were almost \$120 billion

Effects of invasions

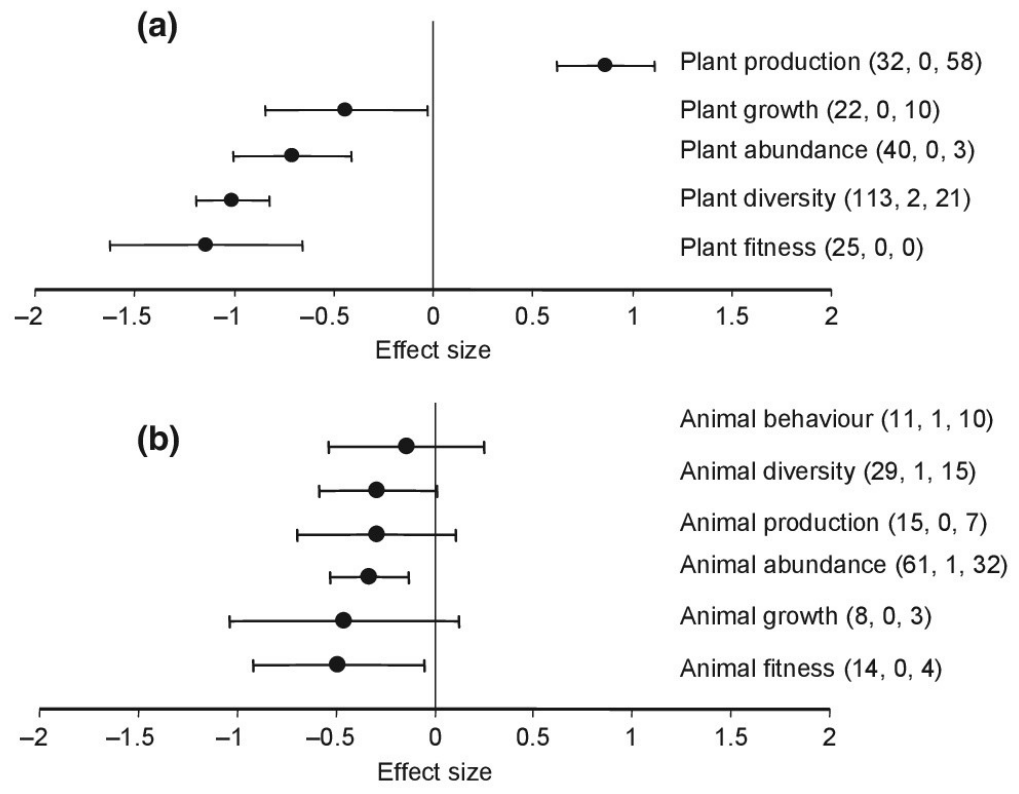


Figure 1 Mean effect size (Hedges' d) of differences between alien plant species impacts to (a) plant species and communities and (b) animal species and communities. The bars around the means denote bias-corrected 95%-bootstrap confidence intervals. A mean effect size is significantly different from zero when its 95% confidence interval do not bracket zero. Positive mean effect sizes indicate that the invaded plots had on average greater values for variables describing a particular impact type. The sample sizes with Hedges' $d < 0$, Hedges' $d = 0$ and Hedges' $d > 0$ are given next to the bars.

Effects of invasions

- In case of some abundant invaders there are no studies to date about their ecological effect
- For example there are almost no study about the effect of common milkweed (*Asclepias syriaca*)

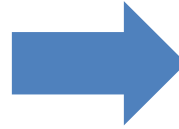


A study about milkweed effect

Milkweed is an invasive species with high dispersal and competitive ability

Invaded extended area in Europe

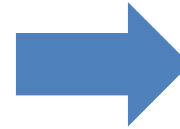
prediction 1



Milkweed is a noxious alien threatening the natural flora

Generally colonise disturbed habitats

Negative effect of milkweed on natural flora does not published to date



prediction 2

Milkweed is a neutral alien with no effect on the natural flora



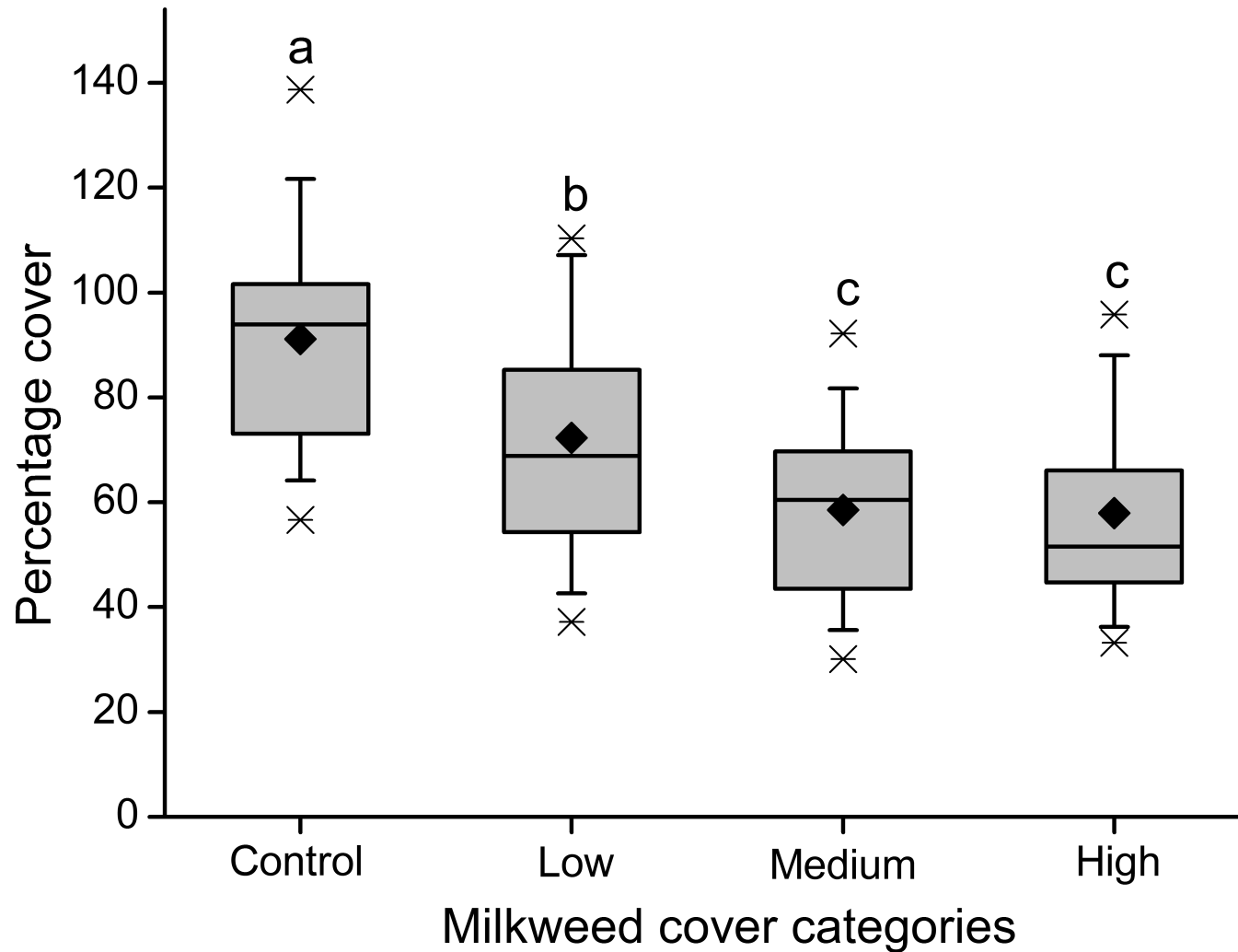
Contradiction between the prognoses



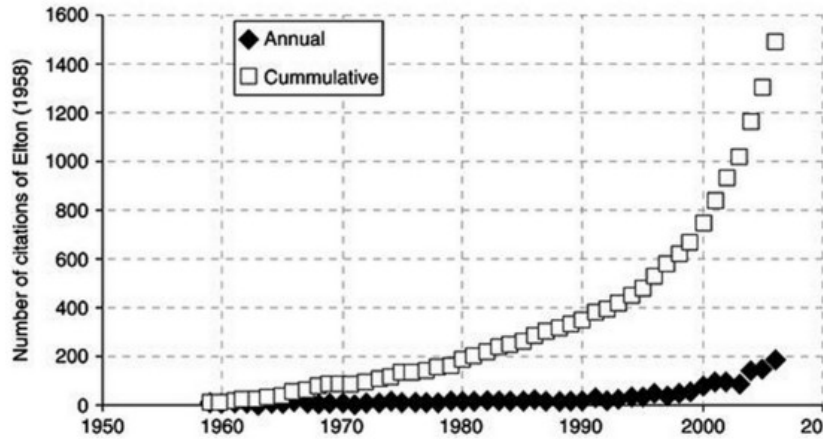
Further studies are required

A study about milkweed effect

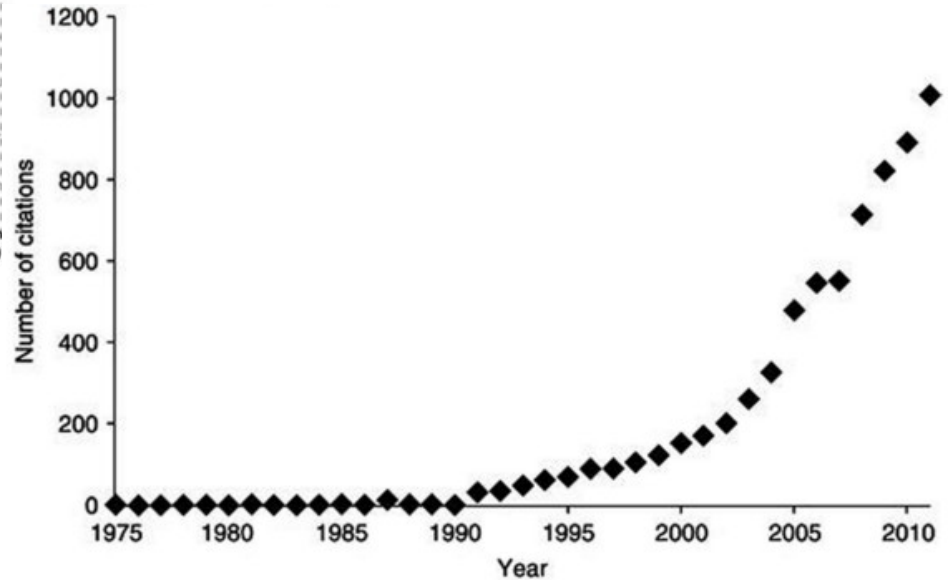
- But the cover of natural grassland species decreased with increasing milkweed cover



Literature outlook

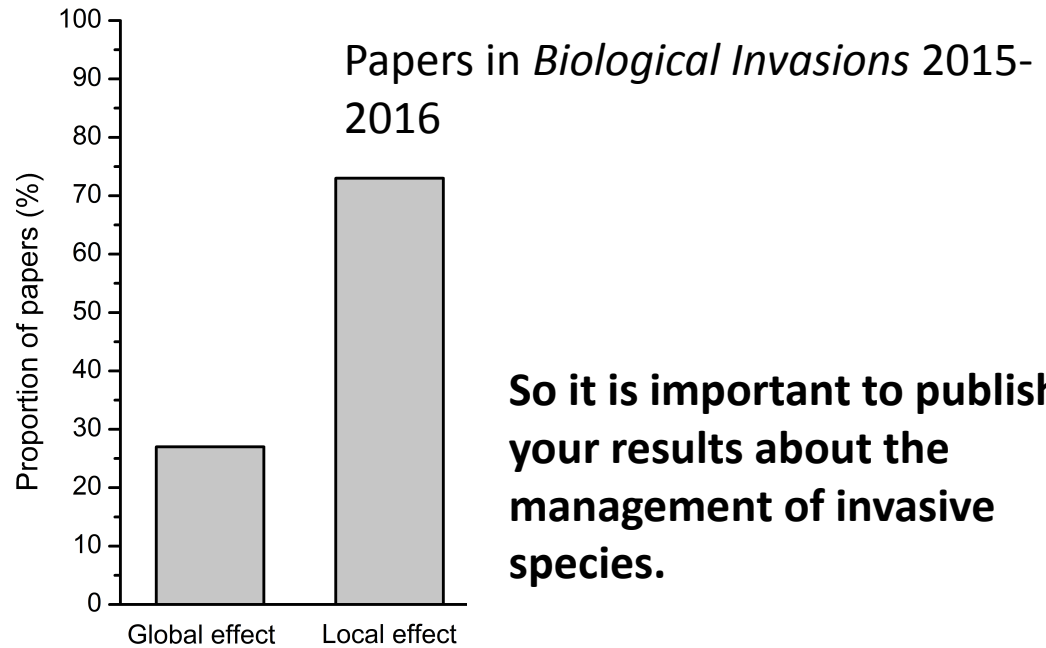
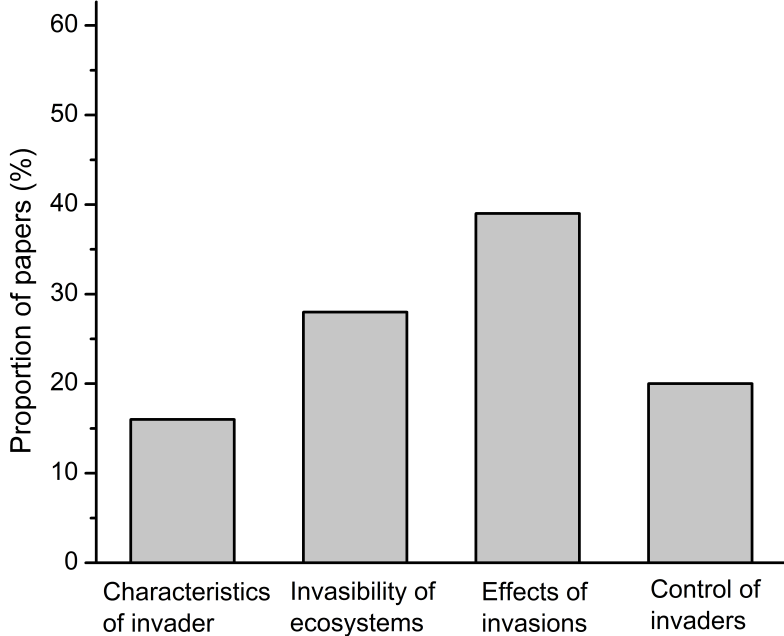
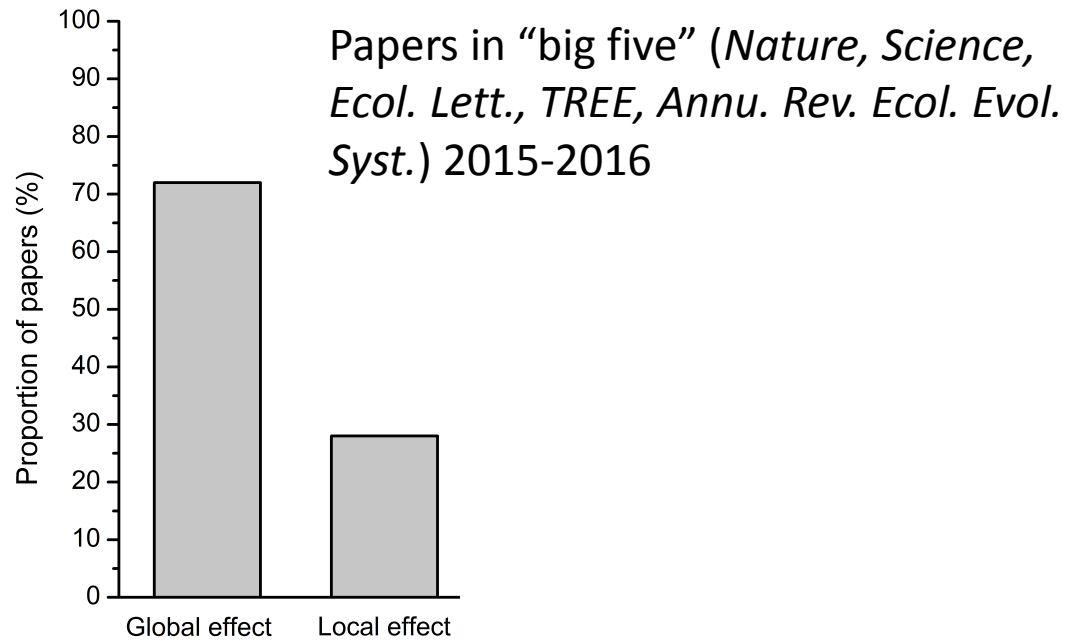
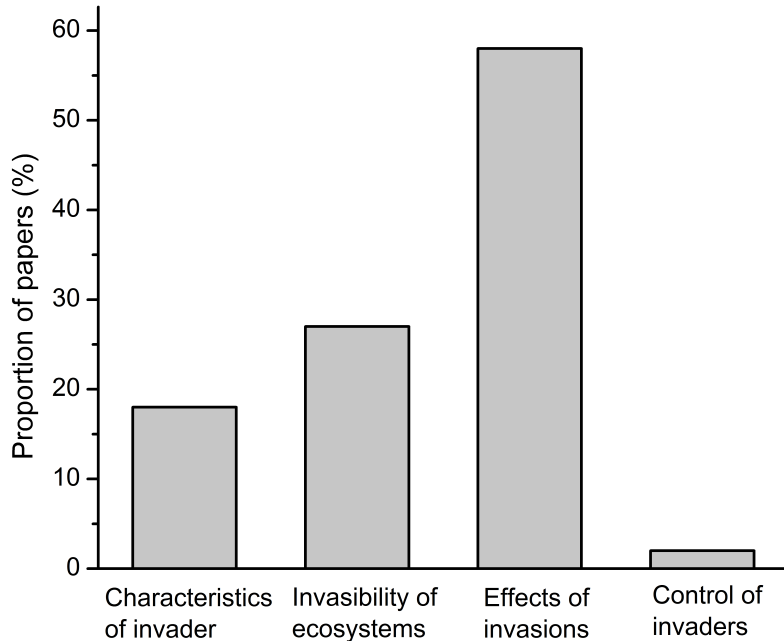


Cummulative number and annual number of citations of Elton's (1958) book "The Ecology of Invasions by Animals and Plants" from Richardson & Pysek (2008).



The number of citations returned from a search of the Science Citation Index using the search terms "invas" and "ecolog" (Simberloff et al. 2012)

Literature outlook



So it is important to publish your results about the management of invasive species.

Thank you for your attention!
Let's arrest the invasions!

