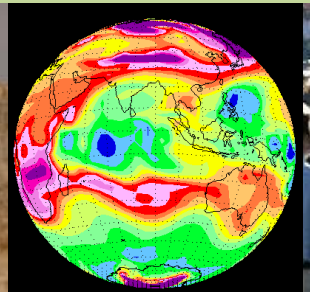
# Invasive species as challenge for science and society

Tina Heger

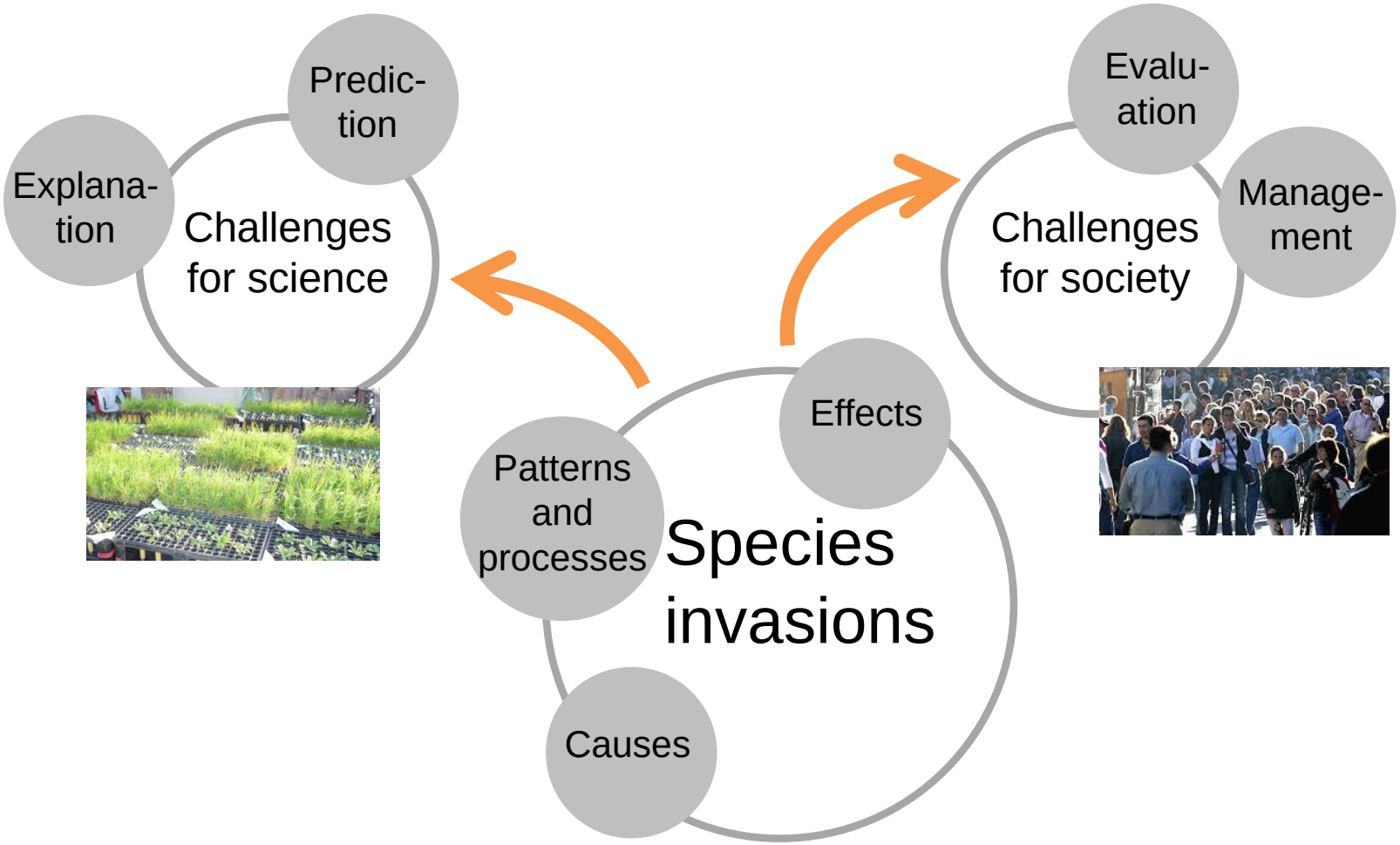


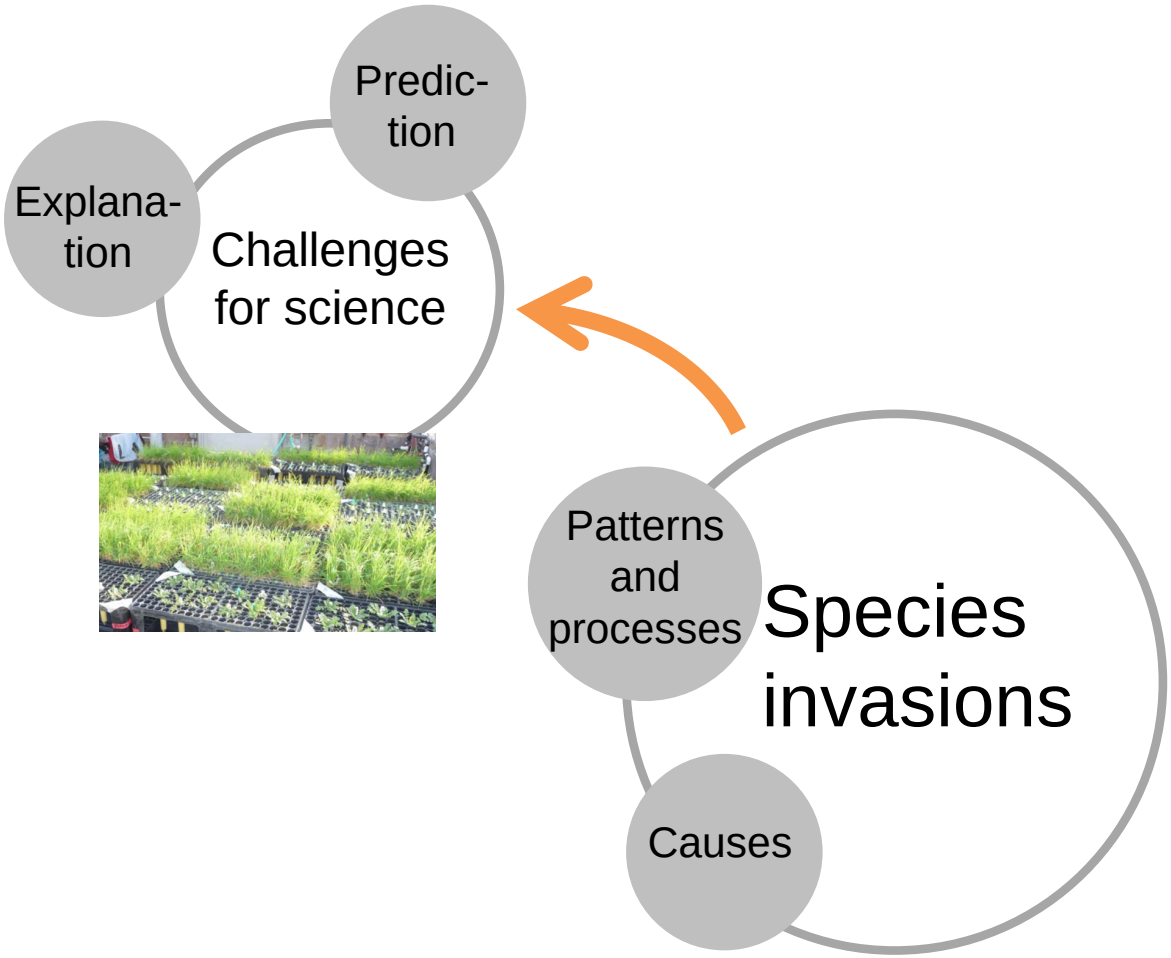

# In-Tree conference: Questions

- Should we plant more non-native tree species in the future?
- If yes: Is it possible to choose species that will not become invasive?
- Can we predict which species will become invasive?
- Or should we avoid non-native tree species in general, because planting them is morally wrong?

# Invasive species as challenge for science and society



# Invasive species as challenge for science



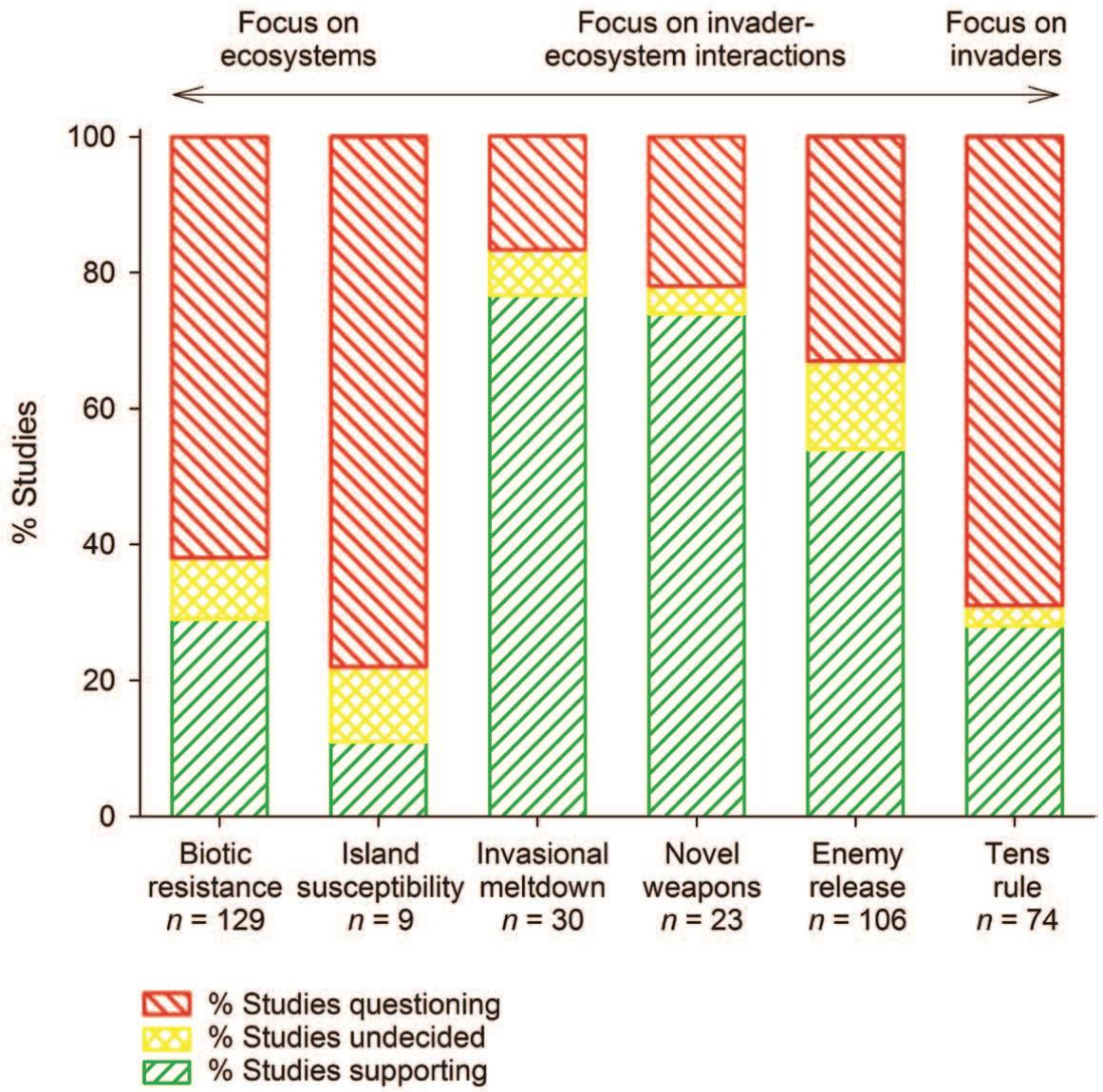
# Invasion hypotheses and empirical evidence

- Standardized literature analysis across animals and plants in terrestrial and aquatic habitats
- 371 studies

Focus on 6 major hypotheses:

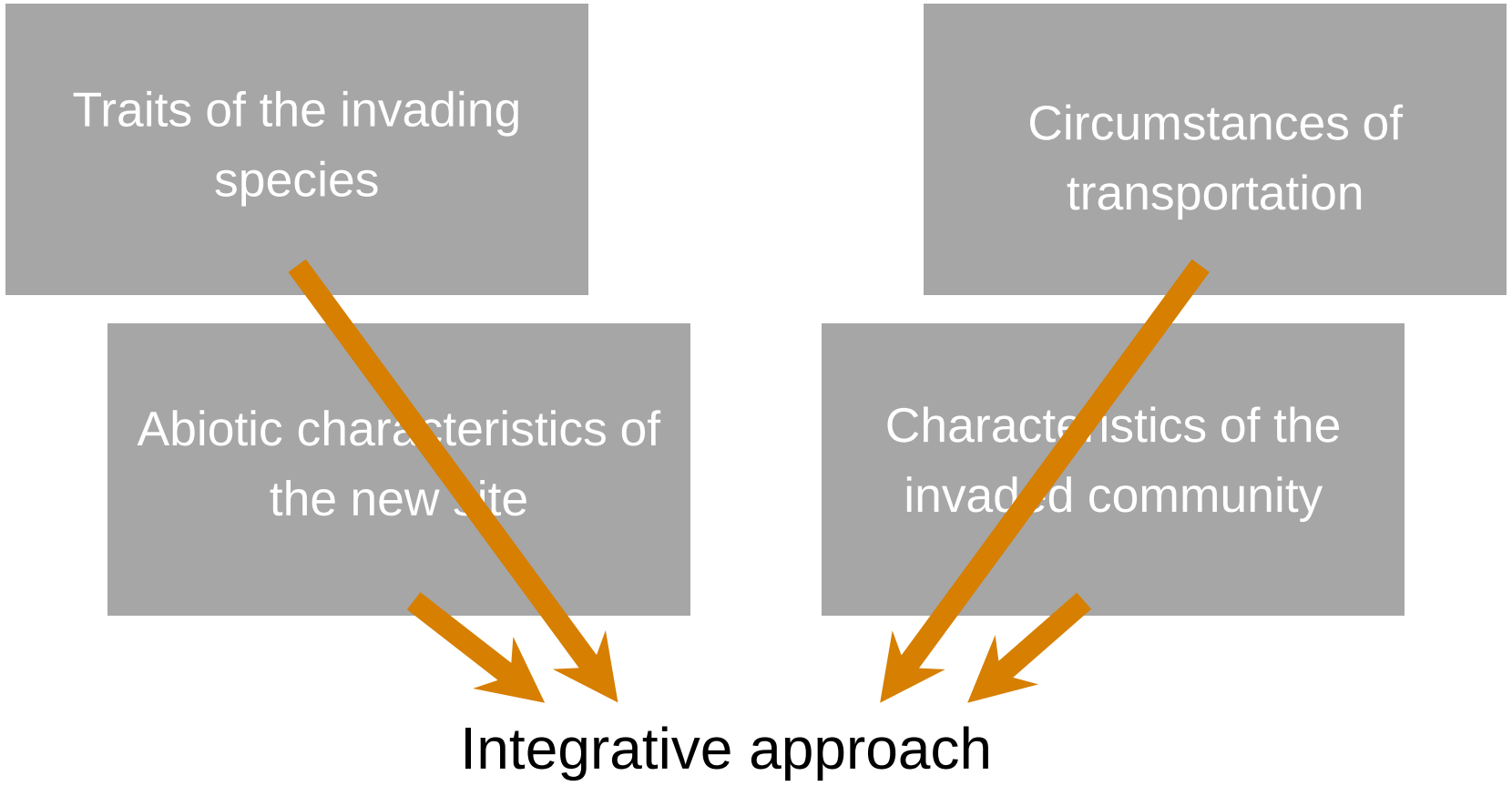
- Biotic resistance hypothesis
- Island susceptibility hypothesis
- Invasional meltdown hypothesis
- Novel weapons hypothesis
- Enemy release hypothesis
- Tens rule

Jeschke et al. 2012 NeoBiota 14: 1-20.

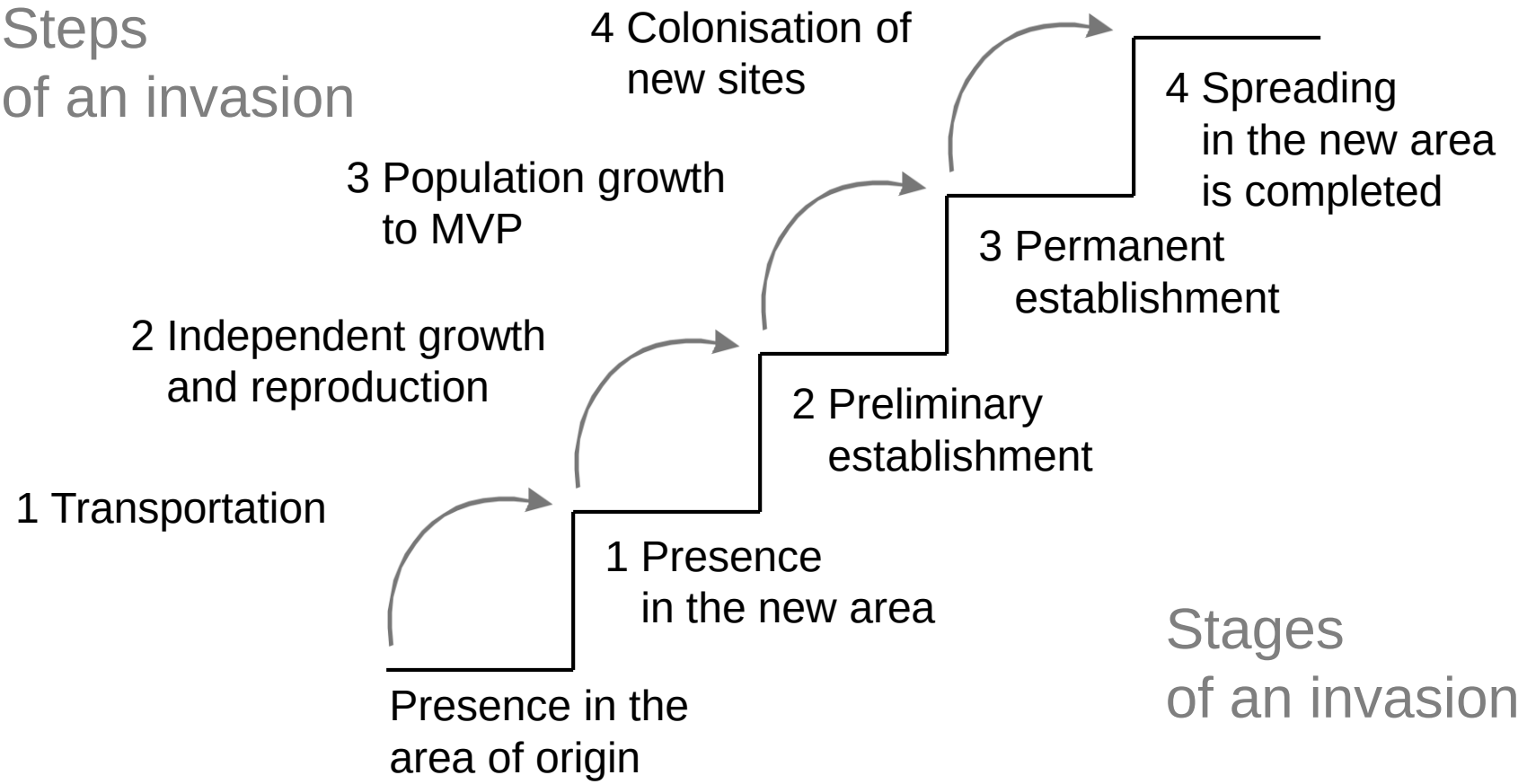



Jeschke et al. 2012 NeoBiota 14: 1-20.

# Which factors decide whether an alien species can establish and spread?

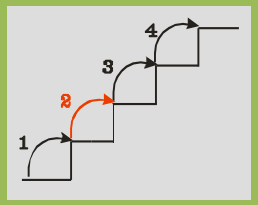


# The Model of Invasion Steps and Stages (INVASS)



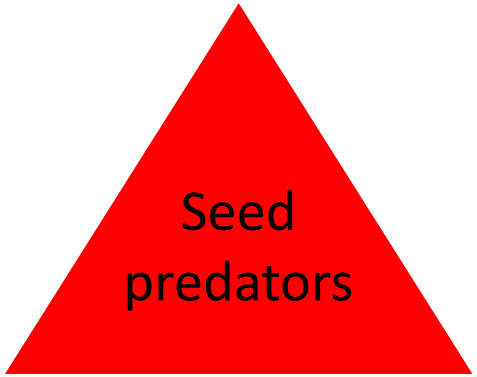

Heger, T. and Trepl, L. (2003) *Biological Invasions, 5(4), 313-321.*

# Example: Invasion step 2 Growth and reproduction




Potential problem

Possible solutions

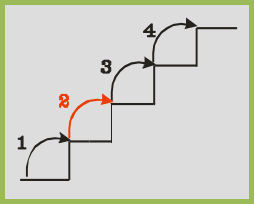




Favorable condition

Heger, T. (2004) NeoBiota 5

# Example: Invasion step 2 Growth and reproduction




Potential problem

Possible solutions

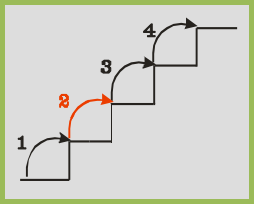
Seed predators

Defense mechanism

Favorable trait

Heger, T. (2004) NeoBiota 5

# Example: Invasion step 2 Growth and reproduction




Potential problem

Possible solutions

Seed predators

Defence mechanism

Favorable trait

Less predators

Favorable condition

Heger, T. (2004) NeoBiota 5

# The Model of Invasion Steps and Stages (INVASS)

INVASS-model:

Favorable traits

- During different steps of an invasion process, different **species characteristics** can be useful
- These species characteristics are only necessary, if the corresponding problems actually do arise

**No species with its specific set of traits**

**is invasive everywhere;**

**its invasiveness depends on where it appears**

Heger, T. (2004) NeoBiota 5

# The Model of Invasion Steps and Stages (INVASS)

INVASS-model:

Favorable condition

- During different steps of an invasion process, different **environmental conditions** can be useful
- These environmental conditions are only necessary, if the corresponding problems actually do arise

**No area is invasible for every species;**
**Invasibility of an area depends on which species appear**

Heger, T. (2004) NeoBiota 5

# Factors hindering prediction

- Context-dependence
- Complexity

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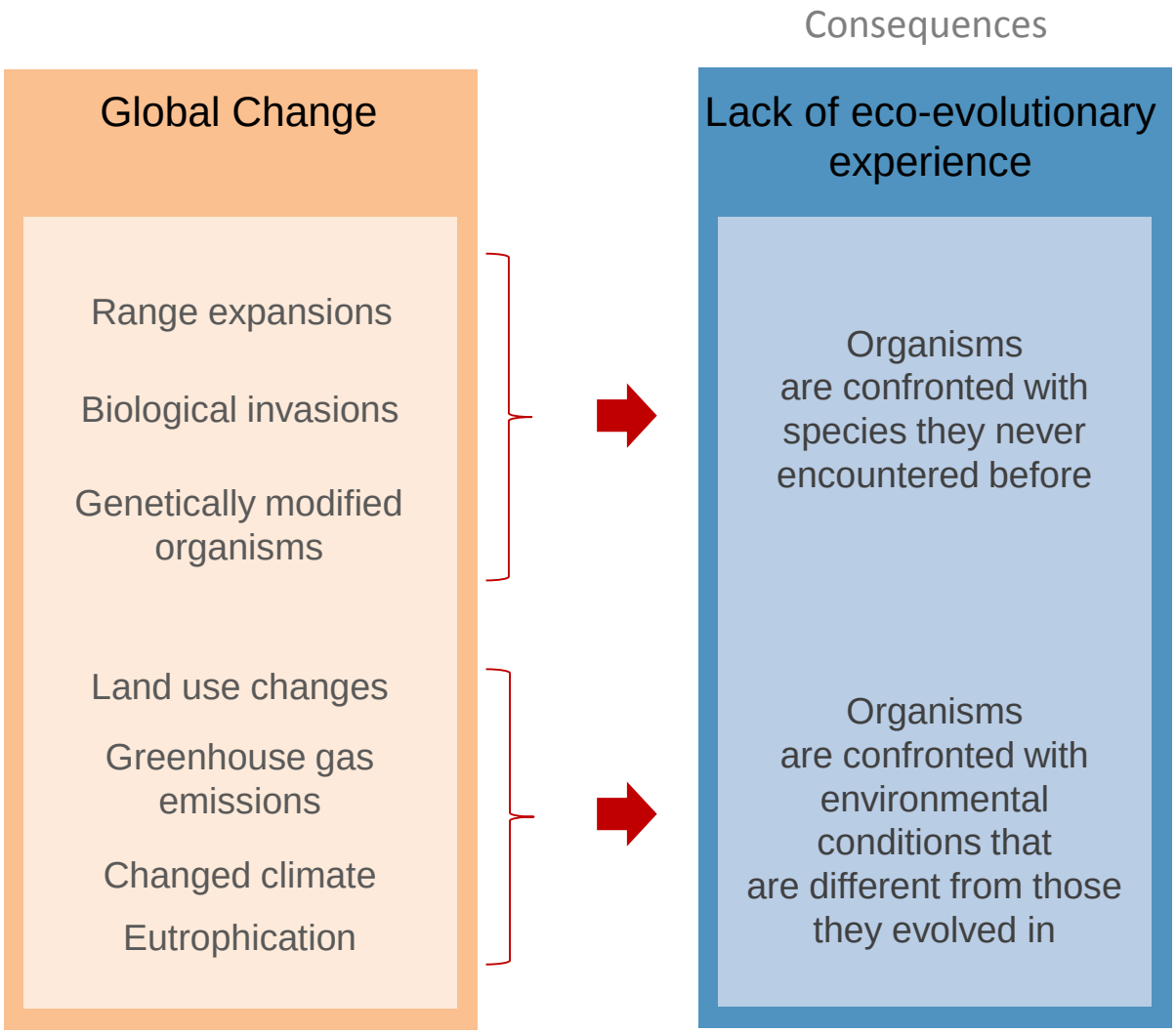
- Ecological novelty

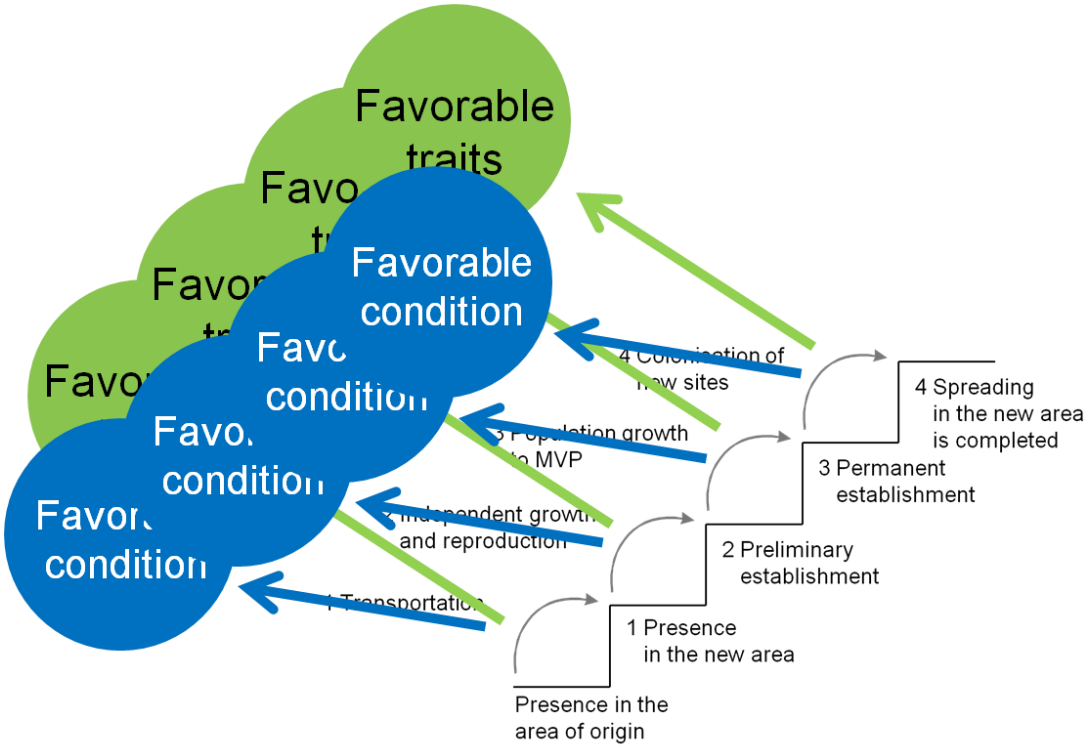
# Factors hindering predictions: Ecological novelty




Heger et al. (2013) *Ambio*; Saul, Jeschke & Heger (2013) *Neobiota*

# Factors hindering predictions: Socio-cultural influences

- During the whole invasion process, not only ecological factors are relevant, but also socio-cultural influences



# Why ecology alone is sometimes not able to explain and predict ‚ecological' patterns

- Example *Impatiens glandulifera* in Tschechoslovakia in the 1960s
- Occurrences not along big rivers, but only along small streams
- Very strange pattern!

# Why ecology alone is sometimes not able to explain and predict ‚ecological' patterns

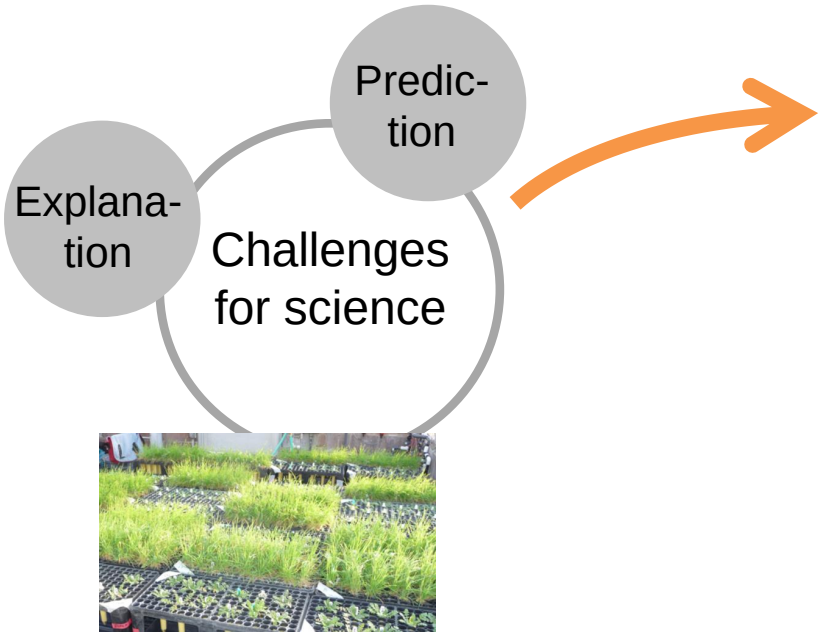
- Reason: Legislation!
- Along small streams, it was allowed to have garden right down to the stream's bank
- Banks of big rivers had to be common property and no garden was allowed to reach down to the bank

# Why ecology alone is sometimes not able to explain and predict ‚ecological' patterns…

## Prediction:

- Would have had to take potential changes in legislation into account!

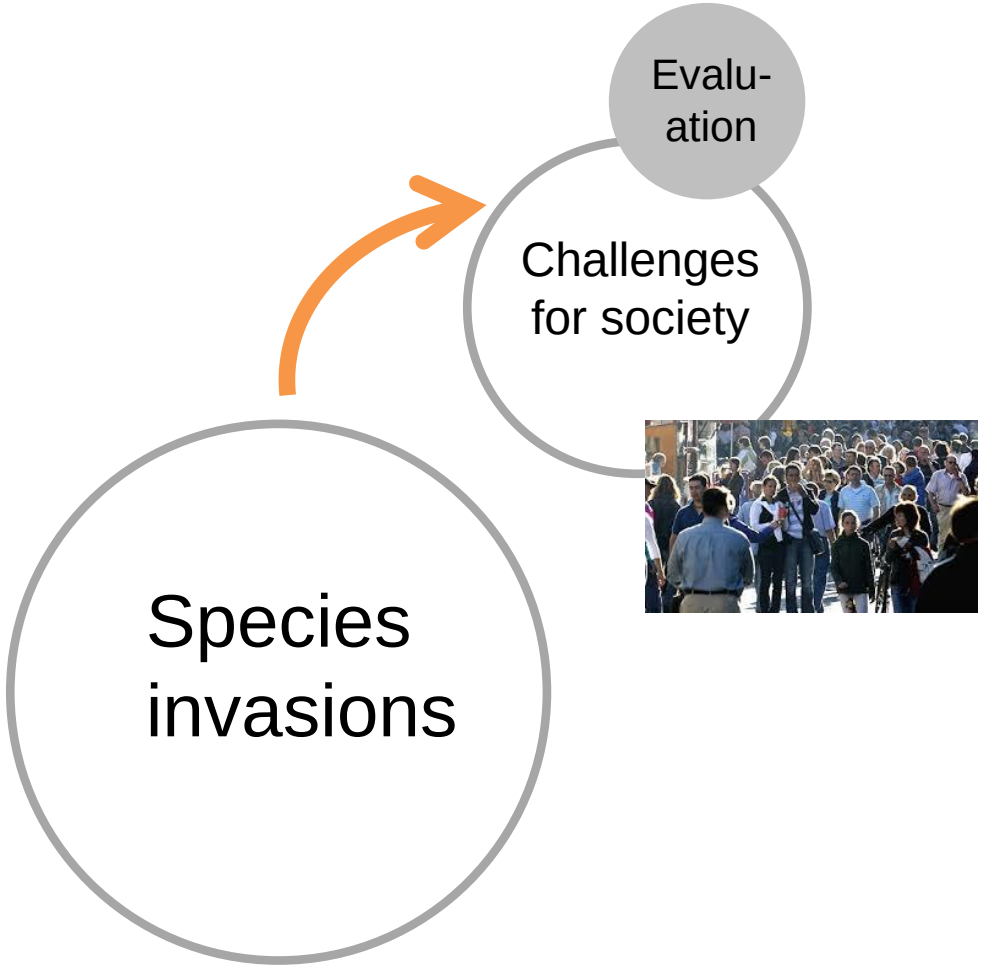
# Conclusions: Invasive species as challenge for science




**Some features inherent to invasion processes are hindering precise predictions:**

- High complexity
- Context dependence
- Ecological novelty
- Evolution
- Socio-cultural influences

# Invasive species as challenge for society



# Why are invasive species evaluated as “bad”?

- Usual response: “Because they have negative impacts on native species and biodiversity”

Mink, *Mustela vison,* with chick http://www.taxidermy.net

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- Usual response: “Because they have negative impacts on native species and biodiversity”

Mink, *Mustela vison,* with chick http://www.taxidermy.net

**But:**

- What exactly does “negative impact” mean?
- Is “preys on chicks” enough already?
- Is “causes a decline in the population size of bird XY” enough?

# Why are invasive species evaluated as “bad”?

- Usual response: “Because they have negative impacts on native species and biodiversity”

Mink, *Mustela vison,* with chick http://www.taxidermy.net

**It’s not, because:**

- Some native species do also prey on chicks
- Population sizes can decline also without the presence of invasive species

# Why are invasive species evaluated as “bad”?

- Usual response: “Because they have negative impacts on native species and biodiversity”

Mink, *Mustela vison,* with chick http://www.taxidermy.net

- Whether impacts are regarded as negative is a **moral decision**
- This decision itself is a step which has to be made **separately**; this is an **ethical process**, outside the realm of natural sciences

# Why are invasive species evaluated as “bad”?

- Usual response: “Because they have negative impacts on native species and biodiversity”

Mink, *Mustela vison,* with chick http://www.taxidermy.net

- Only if the decision has been made, it is possible to **check** whether a species has this kind of impact or not, using methods of **natural sciences**

# Why are invasive species evaluated as “bad”?

- Usual response: “Because they have negative impacts on native species and biodiversity”

This seemingly neat,
seemingly scientifically grounded response
contains implicit moral decisions

# Why are invasive species evaluated as “bad”?

- Uta Eser:

Why invasive species are raising negative emotions
has many reasons rooted in our culture

(see Chapter 2.1!)

**Problem:** Such evaluation processes usually are happening unconsciously and are grounded in everyone’s socio-cultural background

# Definitions and terms – Concepts – “Mind sets”

– What is “food”?

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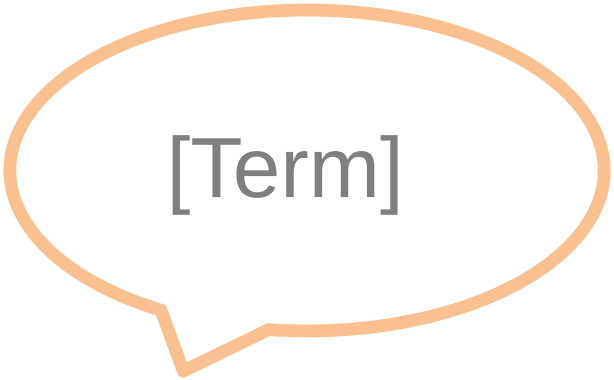
[Term]

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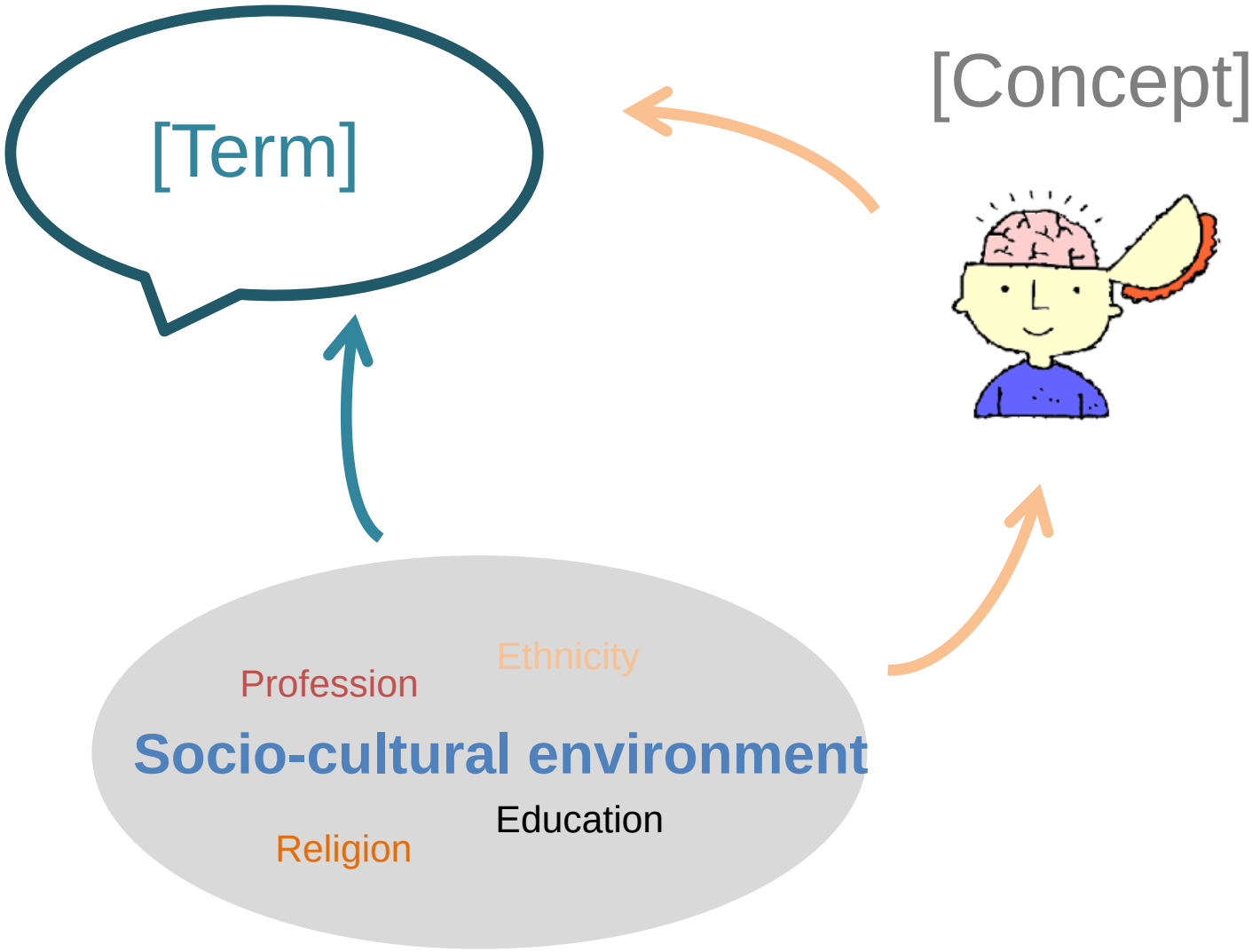
Ethnicity

Profession

**Socio-cultural environment**

Education

Religion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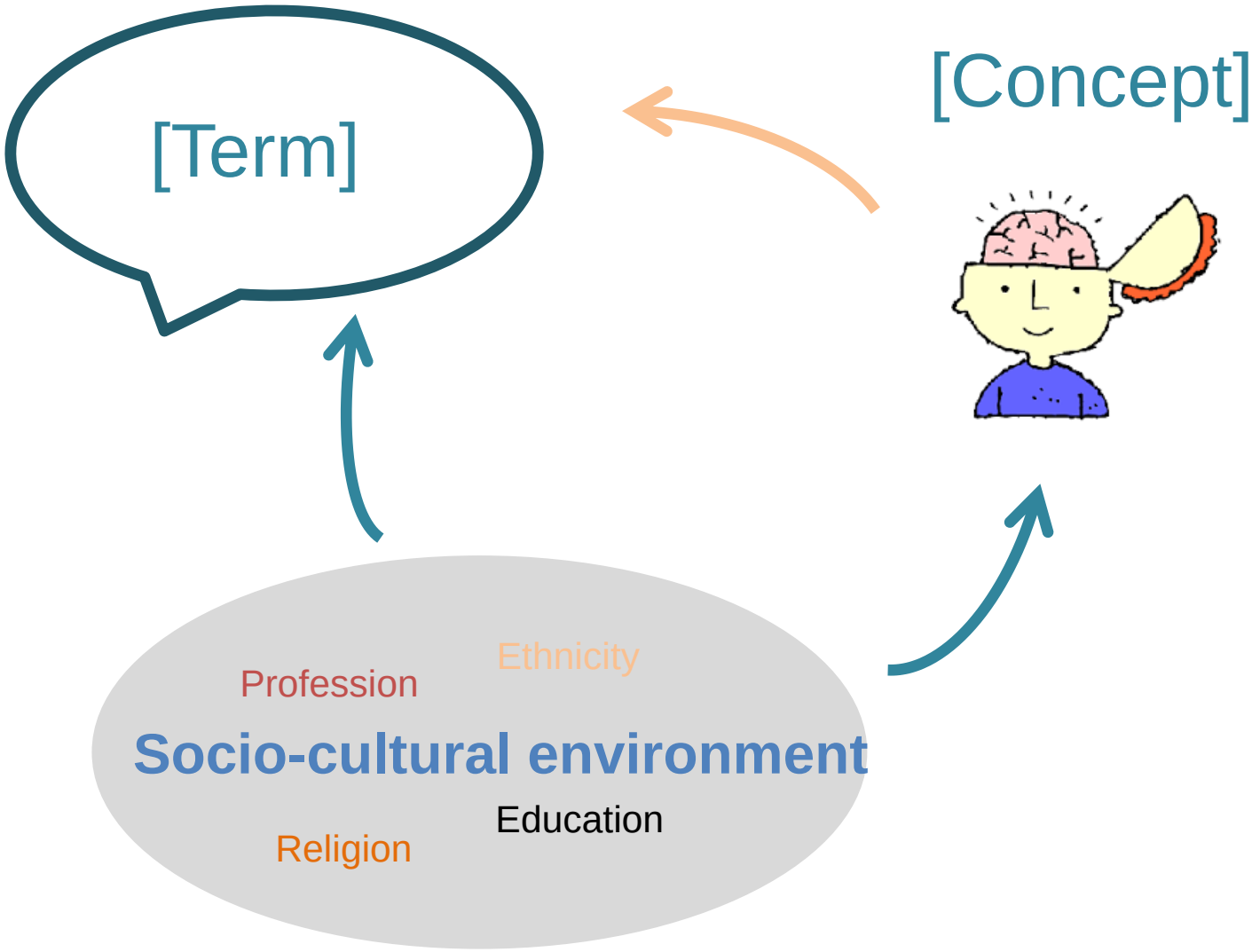
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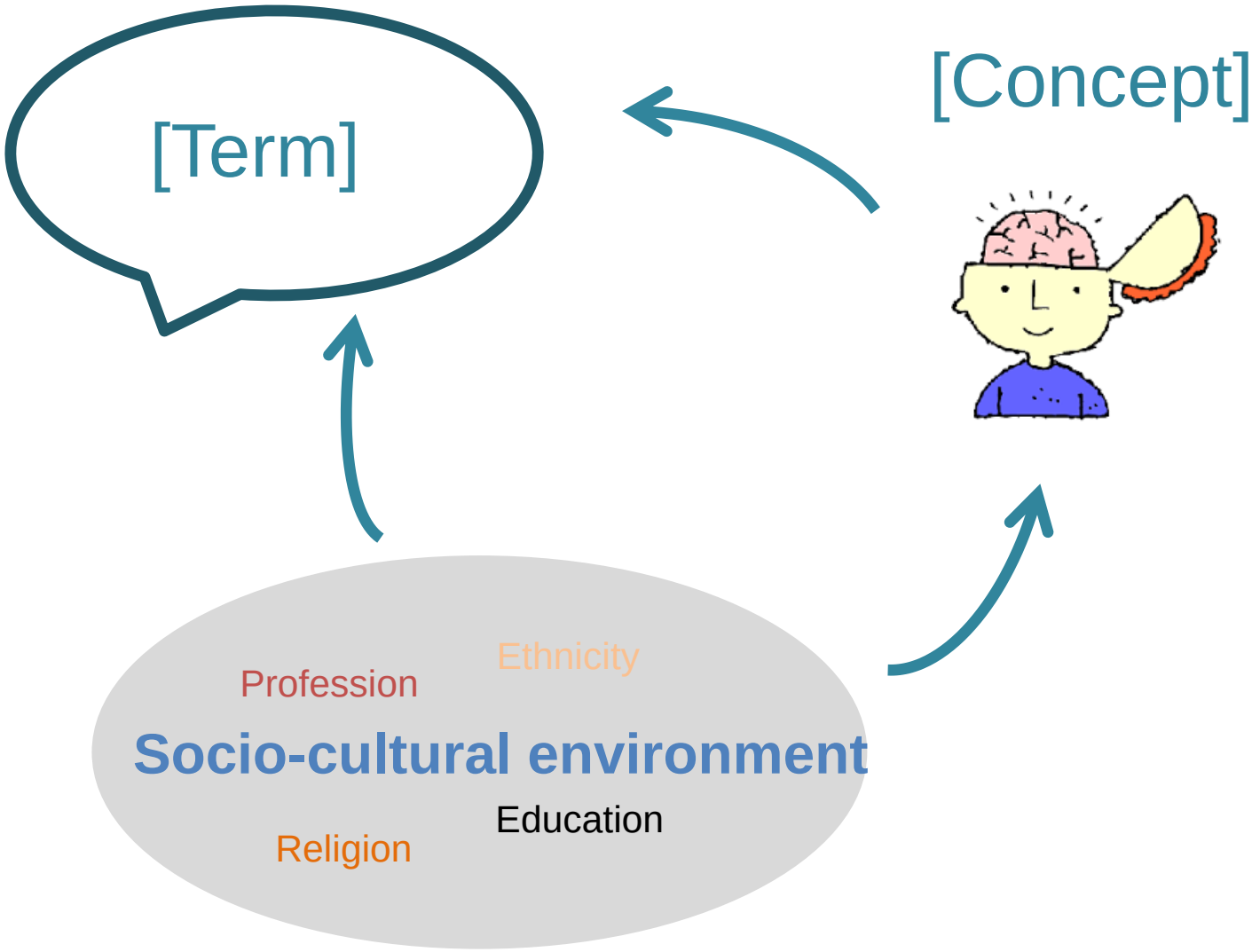
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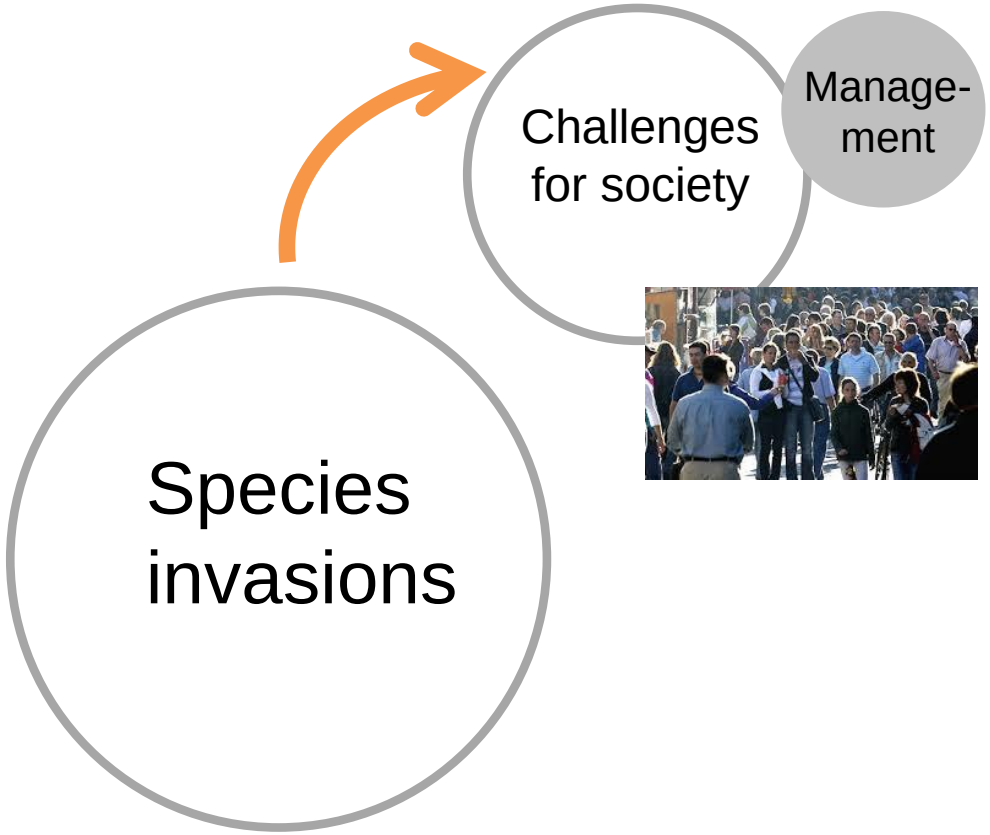
# Conclusions: Invasive species as challenge for society

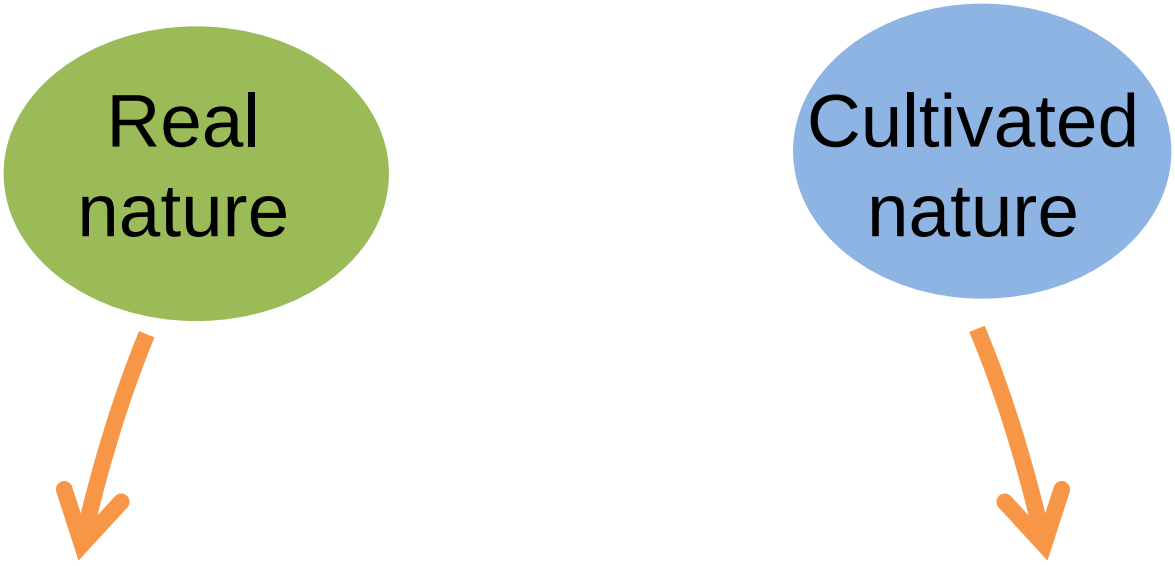
## Controversies on invasive species

- Conflicts usually arise because of fundamentally differing perspectives
- Perspectives will never completely match, because they are rooted in the individuals' socio-economic background
- Controversies thus can only be solved if there is mutual tolerance of the differing perspectives (challenge 1)
- Challenge 2 is to avoid dummy arguments

# Invasive species as challenge for society: Management

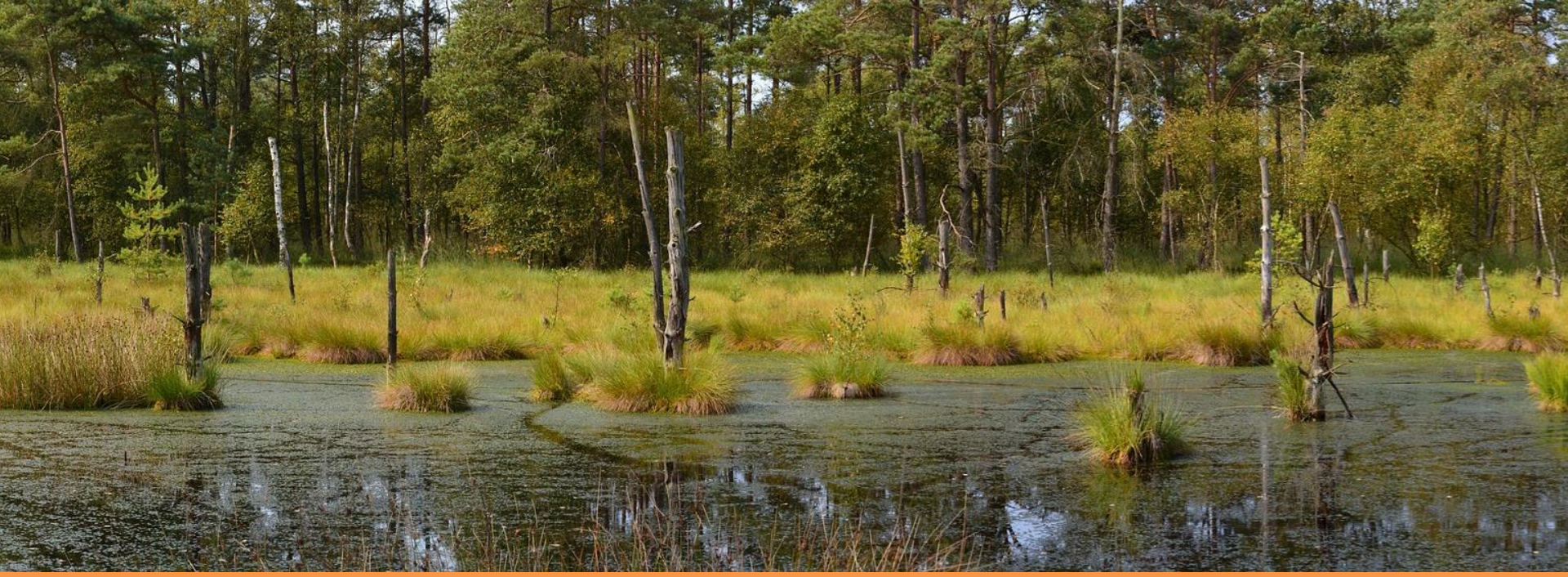


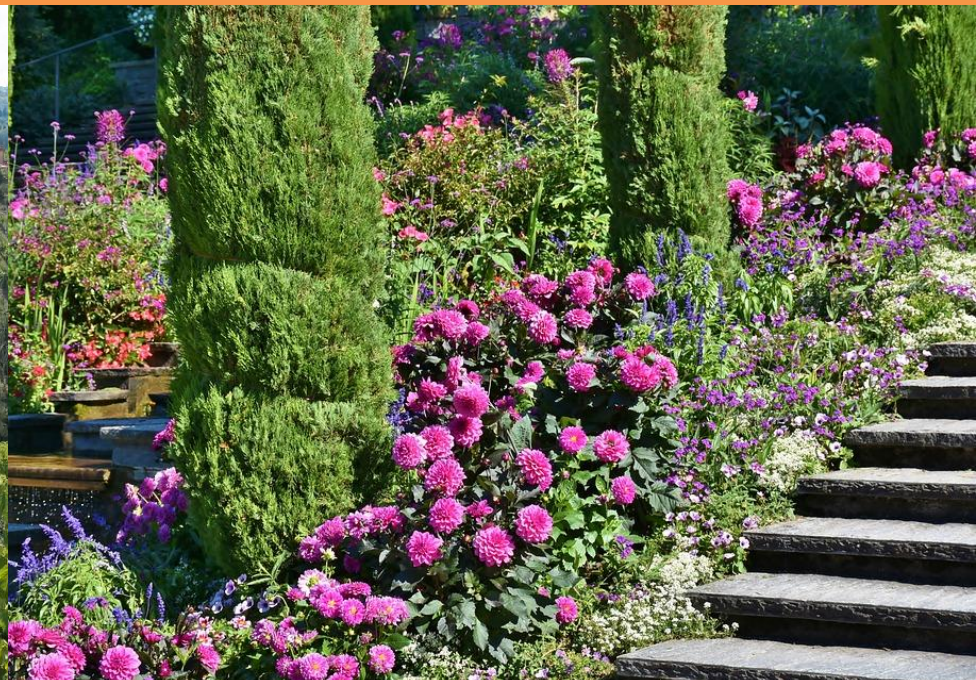
# Traditional view



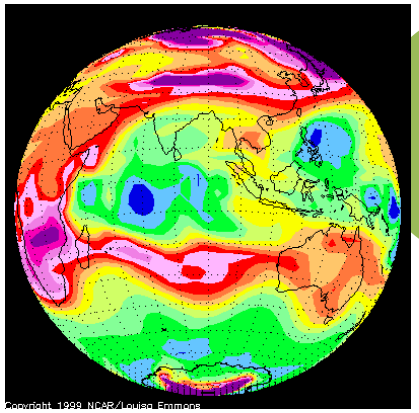

- Pristine
- Wild
- Unmanaged

- Designed
- Subdued
- Artificial





# Today




Real nature

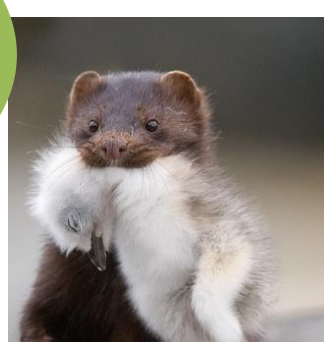
- ~~Pristine~~
- Wild
- Unmanaged

Cultivated nature

- Designed
- Subdued
- Artificial

# Today

Real nature



Cultivated nature

- ~~Pristine~~
- Wild
- ~~Unmanaged~~

- Designed
- Subdued
- Artificial

# Nature or culture?

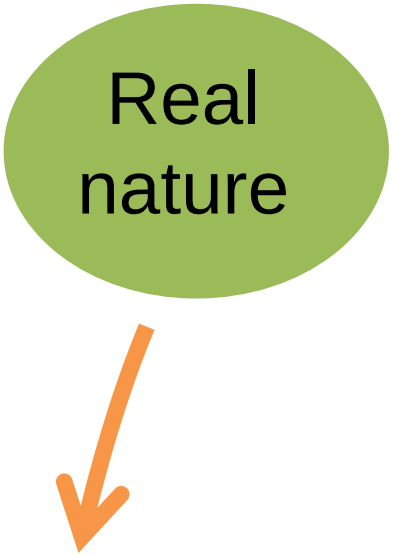
Bishan Park, Singapore, in 2008 (left) with the Kallang River as a concrete canal; and in 2011 (right) with the renaturalised Kallang River.

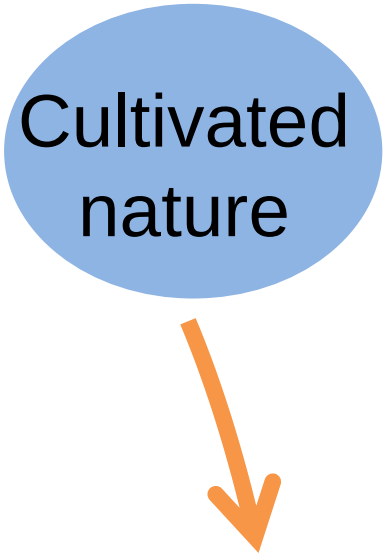
# Nature or culture?

Berlin, Natur-Park Schöneberger Südgelände

Gertrud K. www.flickr.com

# Management options

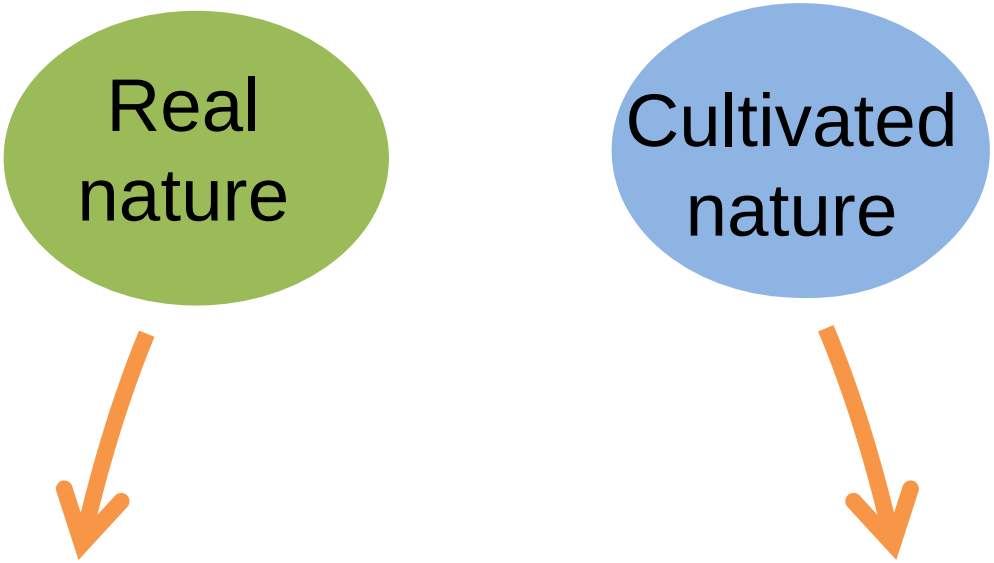



- Leave alone

- Design and manage

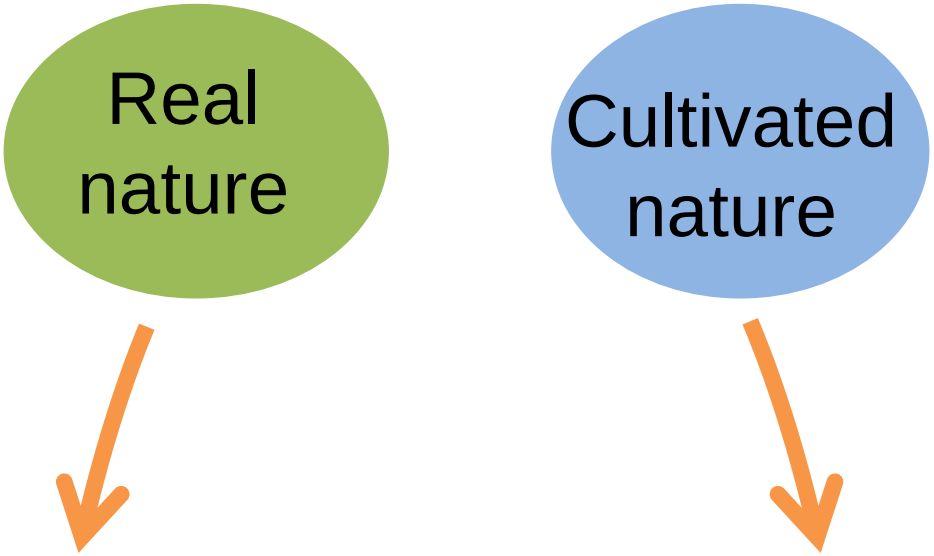
# Management options




- Leave alone
- Manage to be able to conserve

- Design and manage

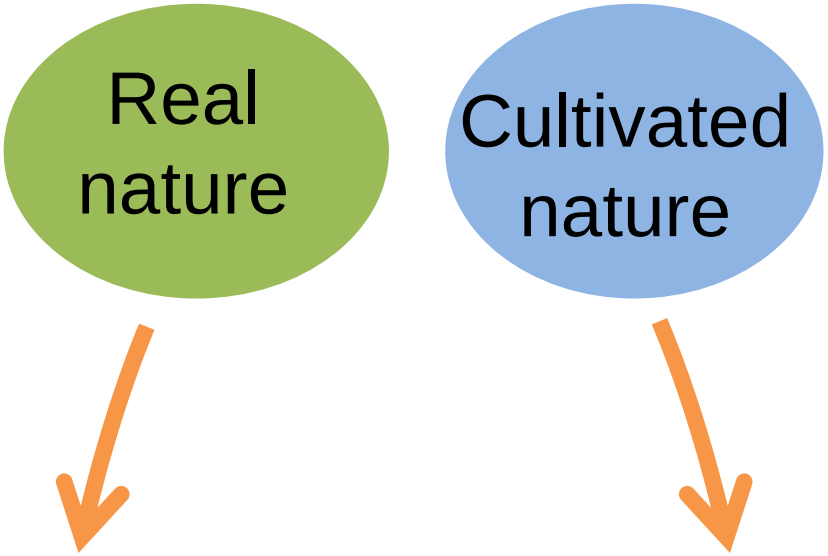
# Management options




- Leave alone
- Manage to be able to conserve
- Restore to reach historic state

- Design and manage

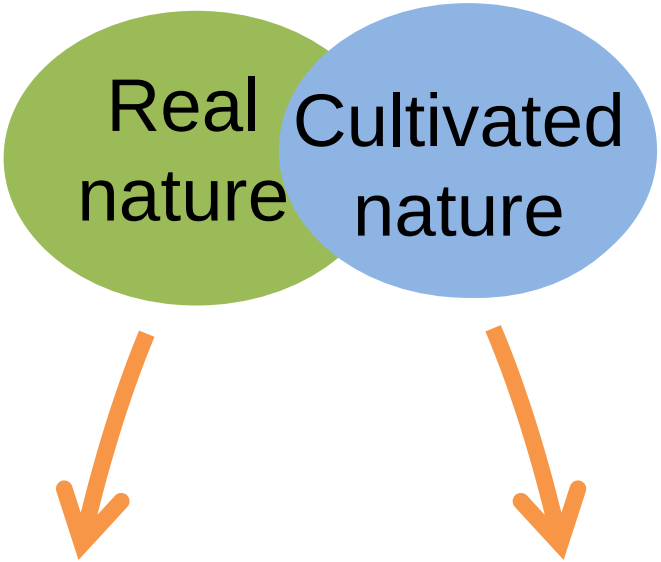
# Management options




- Leave alone
- Manage to be able to conserve
- Restore to reach historic state
- Restore to achieve functioning

- Design and manage

# Management options




- Leave alone
- Manage to be able to conserve
- Restore to reach historic state
- Restore to achieve functioning
- Design to achieve conservation goals
- Design and manage

# Conclusions: Invasive species as challenge for society

## Management options

- “Leave alone” usually is no longer an option if conservation is the aim
- But even if high resources are invested, “historic” states often can longer be recovered
- Therefore, the traditional dichotomies of natural vs. cultural and conservation vs. creation  are not longer valid
- Local decision making does not yet take this into account

# Management options and moral decisions

- Is it wrong to protect endangered species and ecosystems?
- Is it wrong to restore some historic state of an ecosystem or landscape?
- Is it wrong to create ecosystems that fulfil certain functions?
- Is it wrong to do nothing and let invasive species “take over”?

# Management options and moral decisions

- Is it wrong to protect endangered s and ecosystems?
- Is it wrong to restore s e of an ecosystem or land
- Is it wrong t tems that fulfil certai
- nothing at let invasive species ?

**None of this is wrong in every case, and none of it is right in every case**

# Opinion: What we need today

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- We already have a toolbox of options for conservation and management
- We should make full use of all the tools
- Each situation (defined by involved species, ecosystems, stakeholders, available money…) demands for a specific set of measures
- Which tool is the right one should be decided locally,
  ideally based on open minded discussions among involved stakeholders

# Thanks for your attention!

- Ludwig Trepl
- Kurt Jax

- Jonathan Jeschke
- Wolf Saul
- Many students
- WP 5 “novel ecosystems”

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