Forest regeneration after different forestry treatments

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Introduction

Forest cover in Hungary: ~20%

- Managed forests: 96%
- Protected (management restrictions): 21%
- Harmonisation between management and conservation is necessary!

Applied silvicultural systems:

- Rotation forestry, clear-cutting system (artificial regeneration): *lowland forests and plantations*
- Rotation forestry, shelterwood system (natural regeneration): *native submontane forests*
- Continuous cover forestry, selection system → new!, ~4%,

Important to study its effect on...

biodiversity (conservation aspect)

forest regeneration (conservation AND forestry aspect)

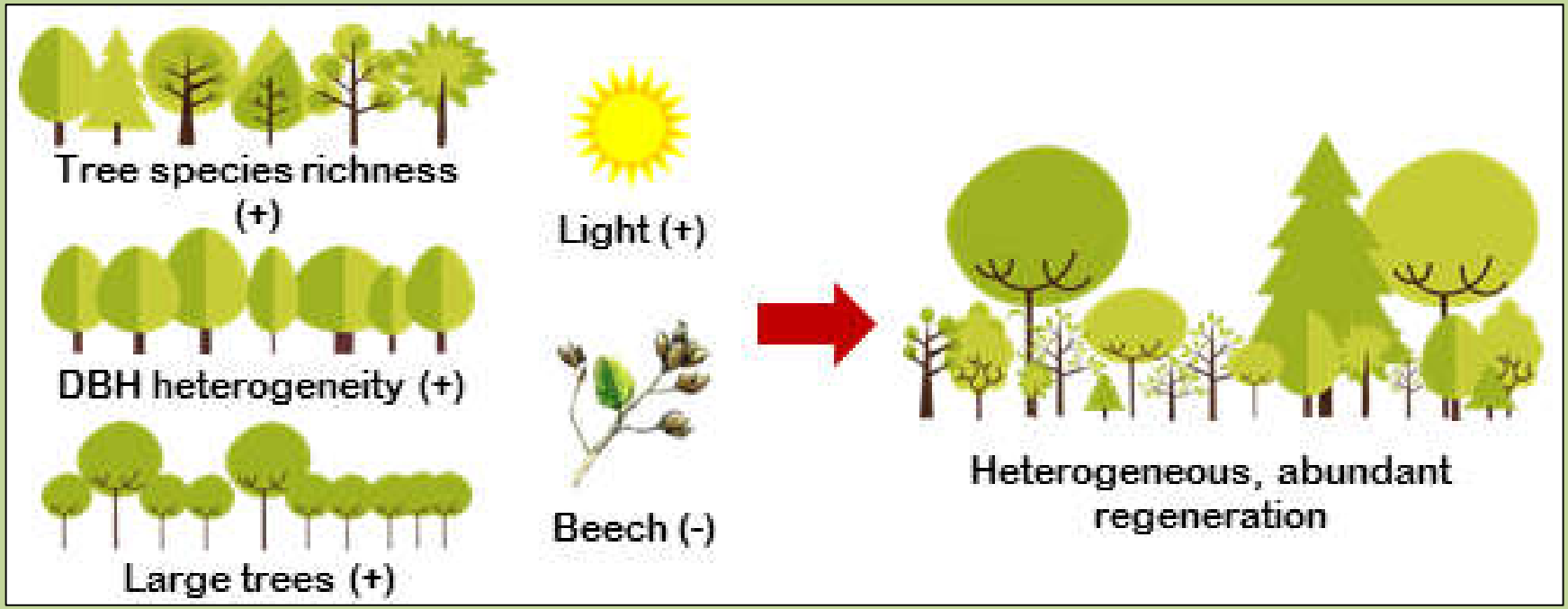
Aim of the current study

- To investigate the effects of different forestry treatments on the forest regeneration

- Is the continuous cover forestry a good alternative for rotation forestry, considering the success of regeneration?

Previous study

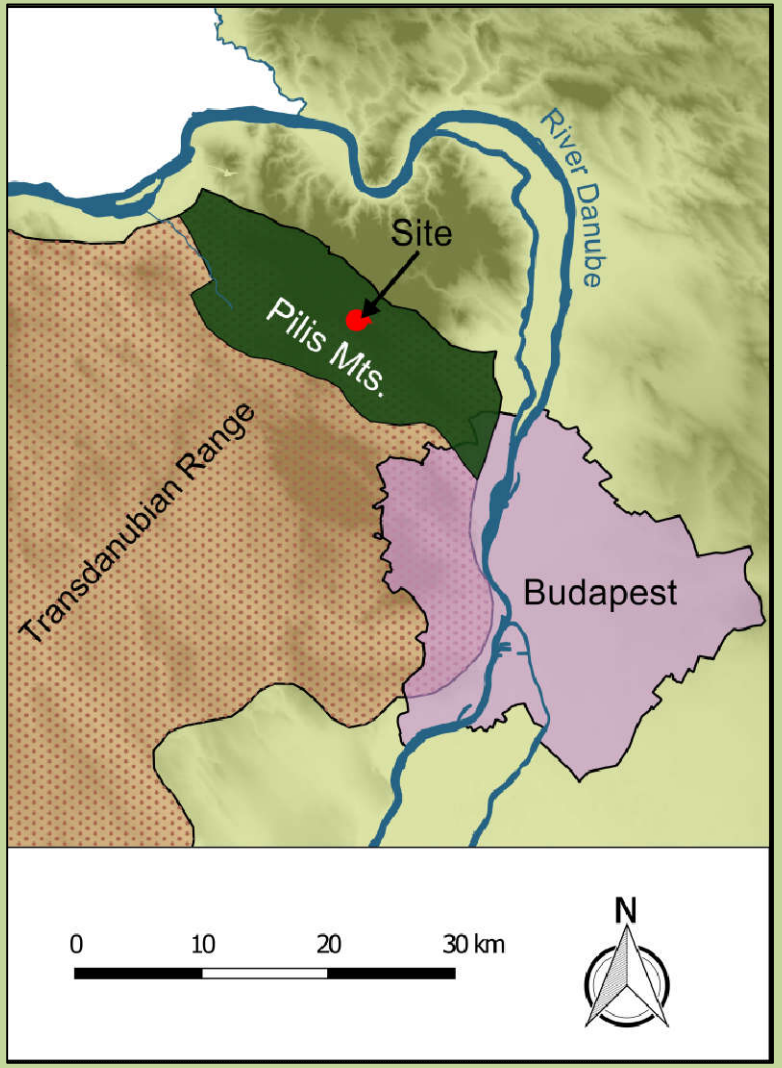
- Őrs-Erdő Project (leader: P. Ódor)
- Tinya, F., Márialigeti, S., Bidló, A., Ódor, P. (2019): Environmental drivers of the forest regeneration in temperate mixed forests Forest Ecology and Management 433: 720-728.



Framework – Pilis Forestry System Experiment

- Head of the project: Péter Ódor

- Pilis Mountains, Hosszú-hill
- 75 year old oak-hornbeam forest



PILISI PARKERDŐ ZRT.

Investigated variables

- Microclimate, soil conditions
- Herbaceous understory vegetation
- Regeneration – F. Tinya, R. Aszalós, B. Kovács, B. Tóth, Zs. Gránitz
- Carabid beetles
- Spiders
- Enchytraeid worms
- Flies







Experimental design

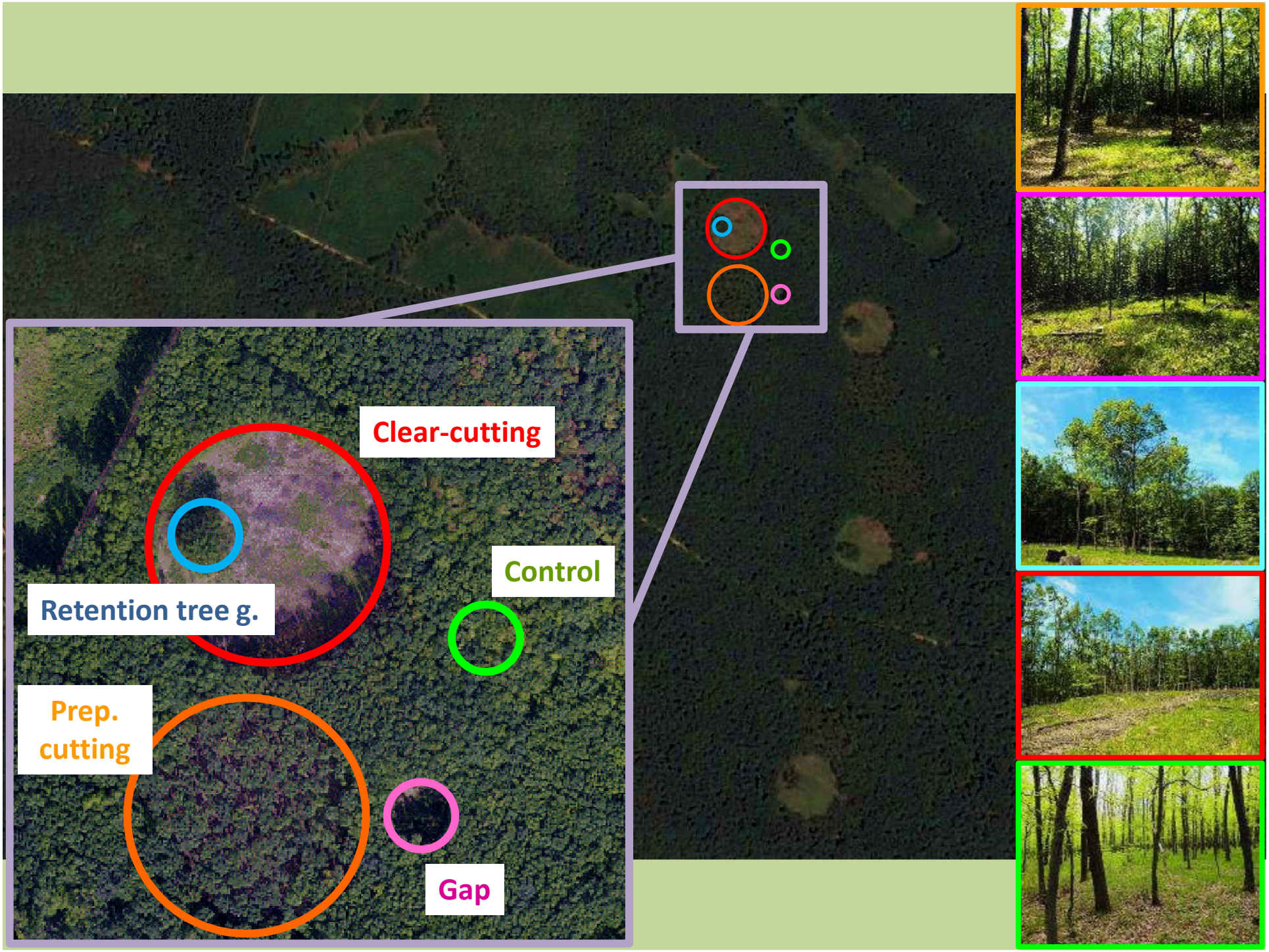
Five treatments:

- Clear-cutting (CC)
- Retention tree group (R)
- Preparation cutting (P)
- Gap-cutting (G)
- Control – closed stand (C)

Six replicates

Complete block design

Interventions: 2014-15 winter


Clear-cutting
Retention tree g.
Control
Prep. cutting
Gap

Regeneration survey

1) Acorn production (B. Kovács)
2) Species richness and abundance of natural regeneration (R. Aszalós)
3) Survival and growth of individual saplings (F. Tinya)

Planned manuscript: Tinya, F., Kovács, B., Aszalós, R., Tóth B., Ódor, P.: Regeneration success of tree species in different forestry treatments in a temperate oak-dominated forest

Methods

1) **Acorn production**

   1x1 m quadrates/plot

   number of fallen acorns (sessile oak - *Quercus petraea*)

   2014, 2015, 2016, 2018

   ↓ ↓

   Masting years

Methods

2) Species richness and abundance of natural regeneration

2x2 m fenced quadrats/plot

Amount of saplings for every woody species

4 size-categories:

1: 0-20 cm

2: 20-50 cm

3: 50-130 cm

4: >130, DBH<5 cm

2014-2018 yearly

Methods

2) Species richness and abundance of natural regeneration

Analysed species/species groups:

- Sessile oak (*Quercus petraea*)
- Hornbeam (*Carpinus betulus*)
- Manna ash (*Fraxinus ornus*)
- Endozoochor species (*Cornus sanguinea, Crataegus monogyna, Malus sylvestris, Prunus avium, Prunus spinosa, Rosa canina, Sorbus torminalis*)




Methods

3) Survival and growth of individual saplings

- Natural saplings
- **Planted saplings:**

  Sessile oak (*Quercus petraea*)

  Turkey oak (*Quercus cerris*)

  Hornbeam (*Carpinus betulus)*

  Beech (*Fagus sylvatica*)

  Common ash (*Fraxinus excelsior*)





Methods

3) Survival and growth of individual saplings

- Planted saplings:

  Planting: 2014 (replacement of died saplings: 2015)

  5 saplings /species/plot, in fenced area

  Altogehter 750 saplings (423 in the analysis)

  Survival, height, stem diameter, shoot number, leaf area

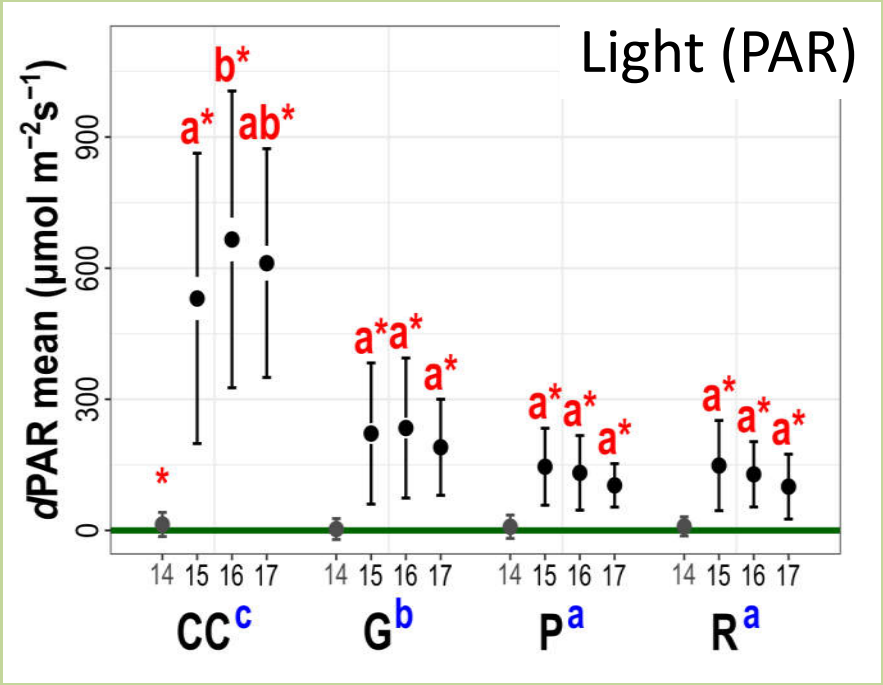
  2014-2018 yearly

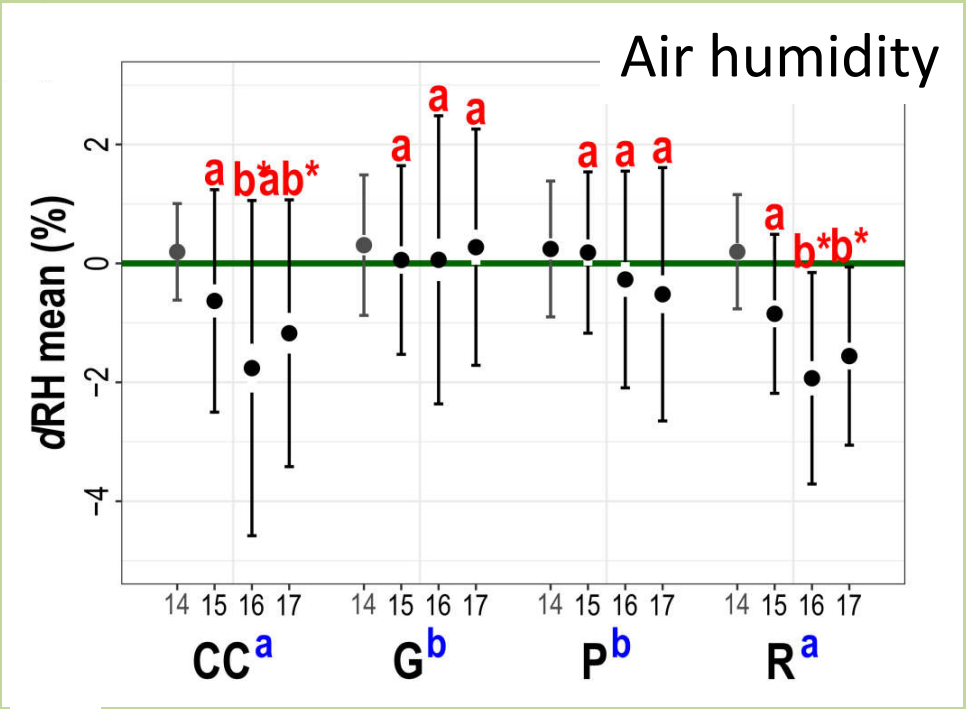
Methods - Data analysis

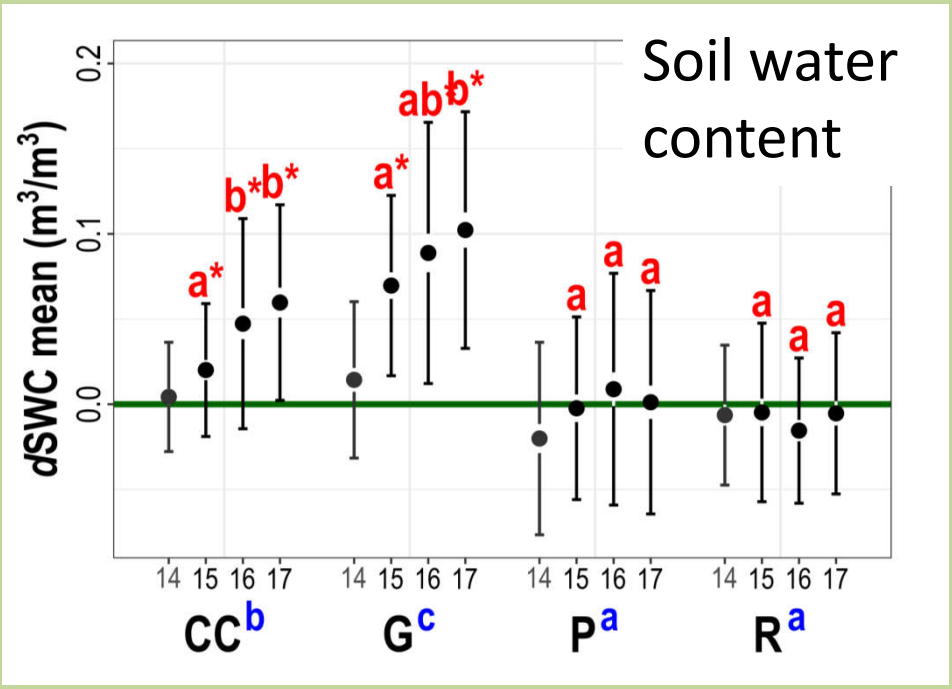
- Here: data of the 1st and 4th years after the interventions (2015 and 2018)

- General and generalized linear mixed models
- Fix factor: treatment
- Random factor: block
- Post-hoc tests with user-defined contrasts
- R package

Microclimatic background



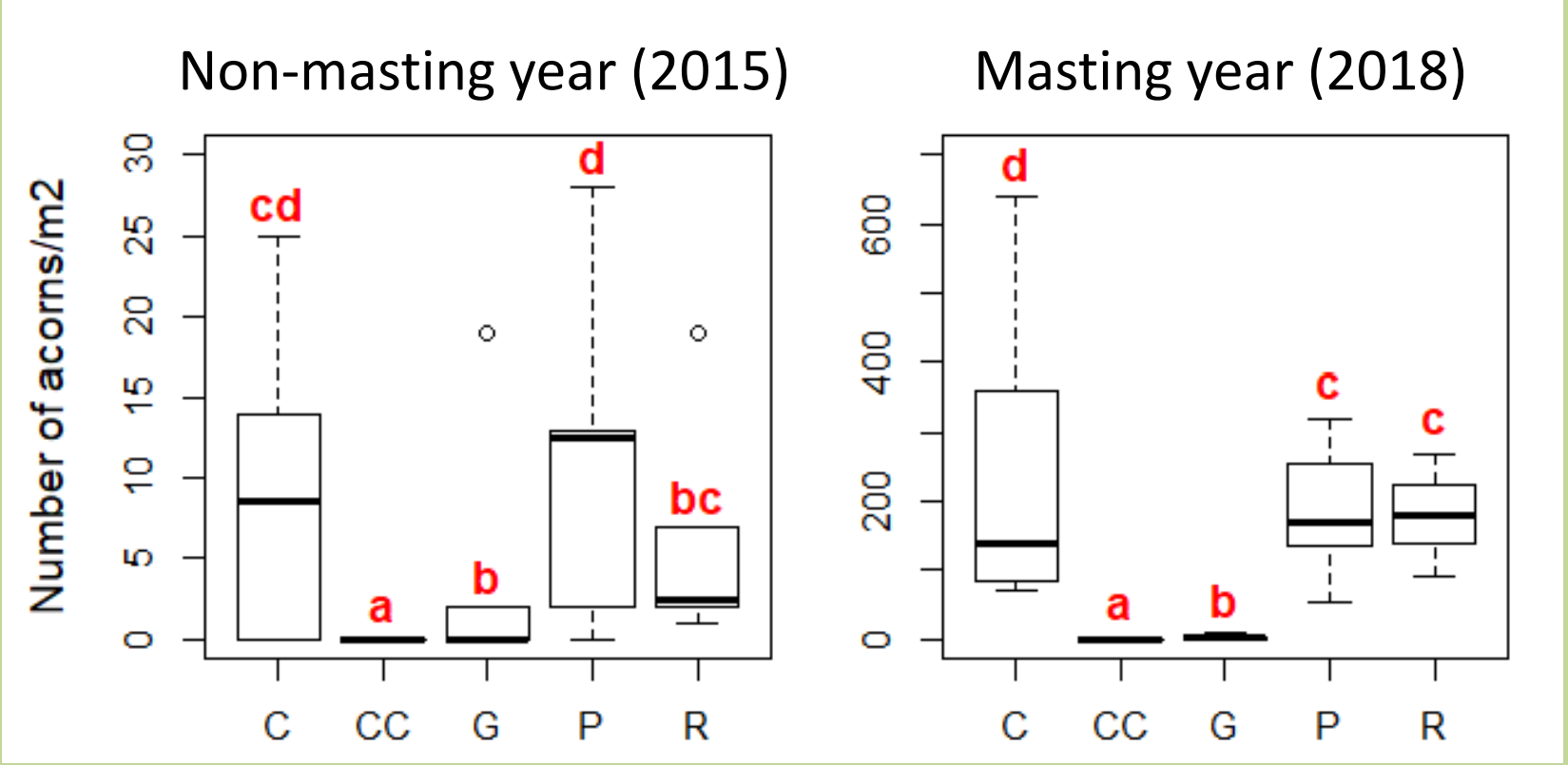




CC - Clear-cutting
G – Gap
P – Preaparation cutting
R – Retention tree group

Results
1) Acorn production

C – Control
CC - Clear-cutting
G – Gap
P – Preaparation cutting
R – Retention tree group



No acorns in the clear-cutting, neither in masting years
Very few acorns in the gaps, even in the masting years
In masting years many acorns in the closed stand, preparation cutting, retention tree group

Results
2) Species richness of natural regeneration

C – Control
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G – Gap
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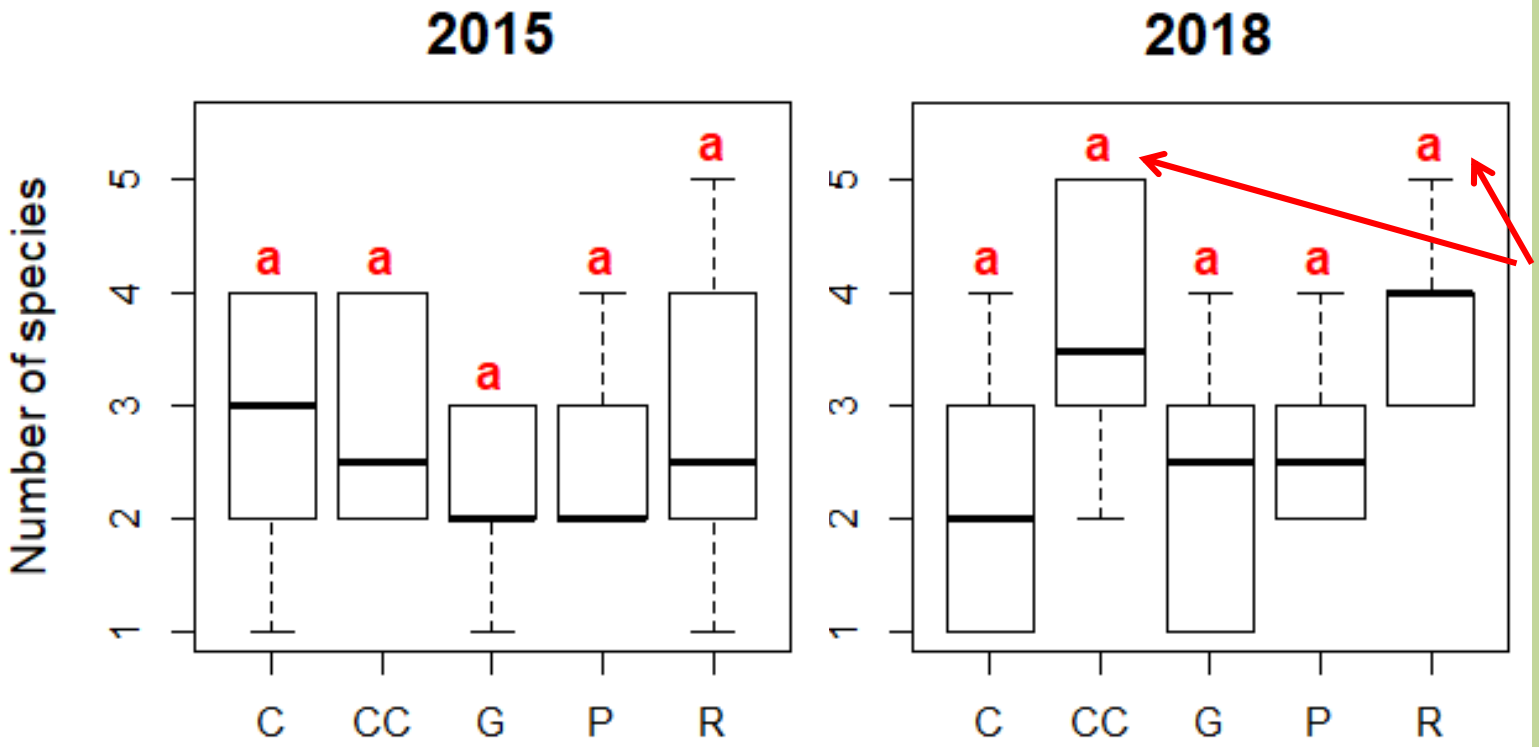
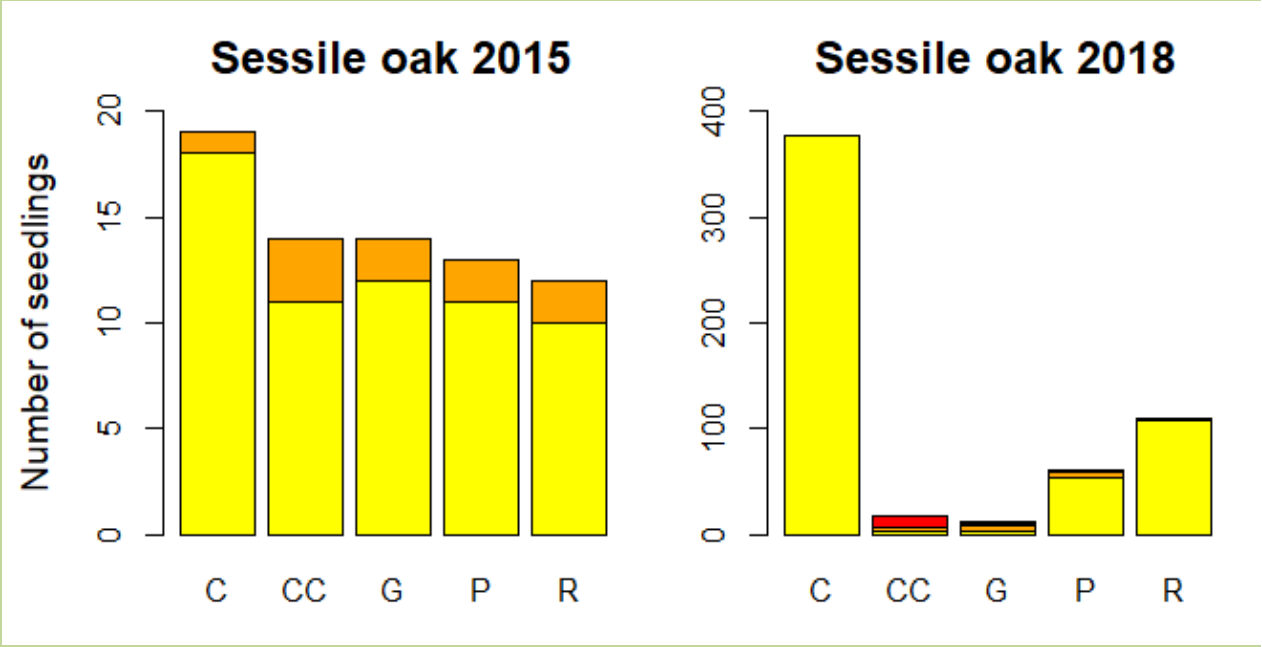
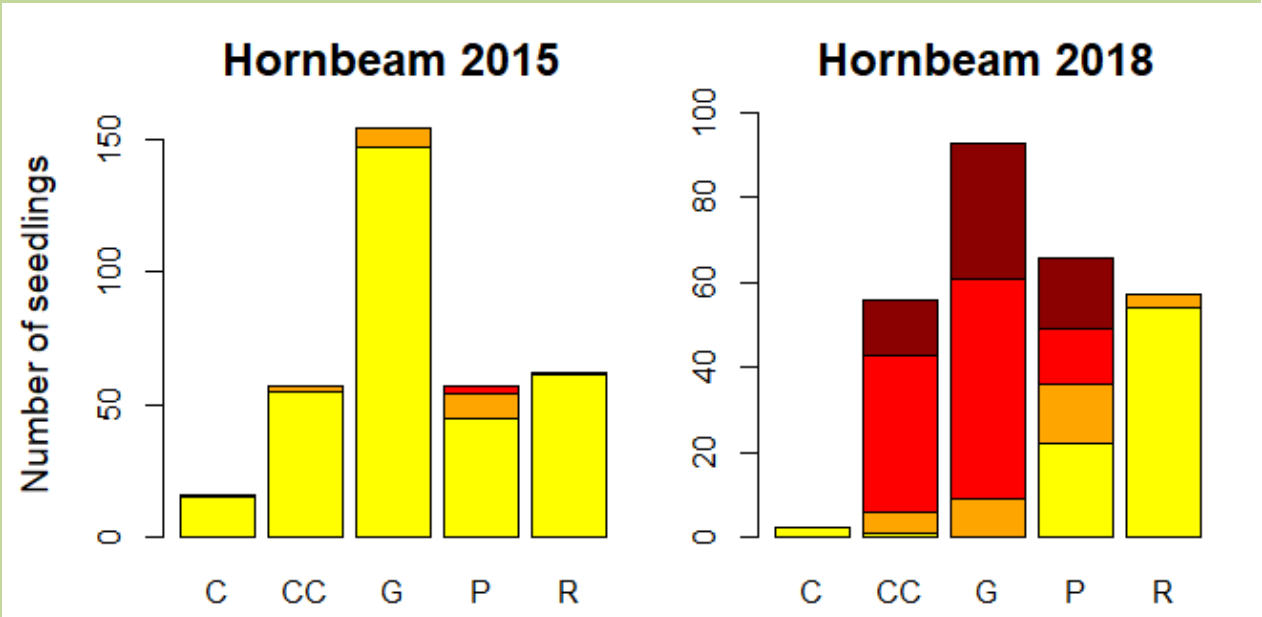


endozoochor species (= wild fruits) and pioneer species

Trend: more species in the clear-cutting and in the retention tree group
No significant differences between the treatments – yet...

Results
2) Abundance of natural regeneration





Size categories:

- 0-20 cm
- 20-50 cm
- 50-130 cm
- >130 cm

C – Control
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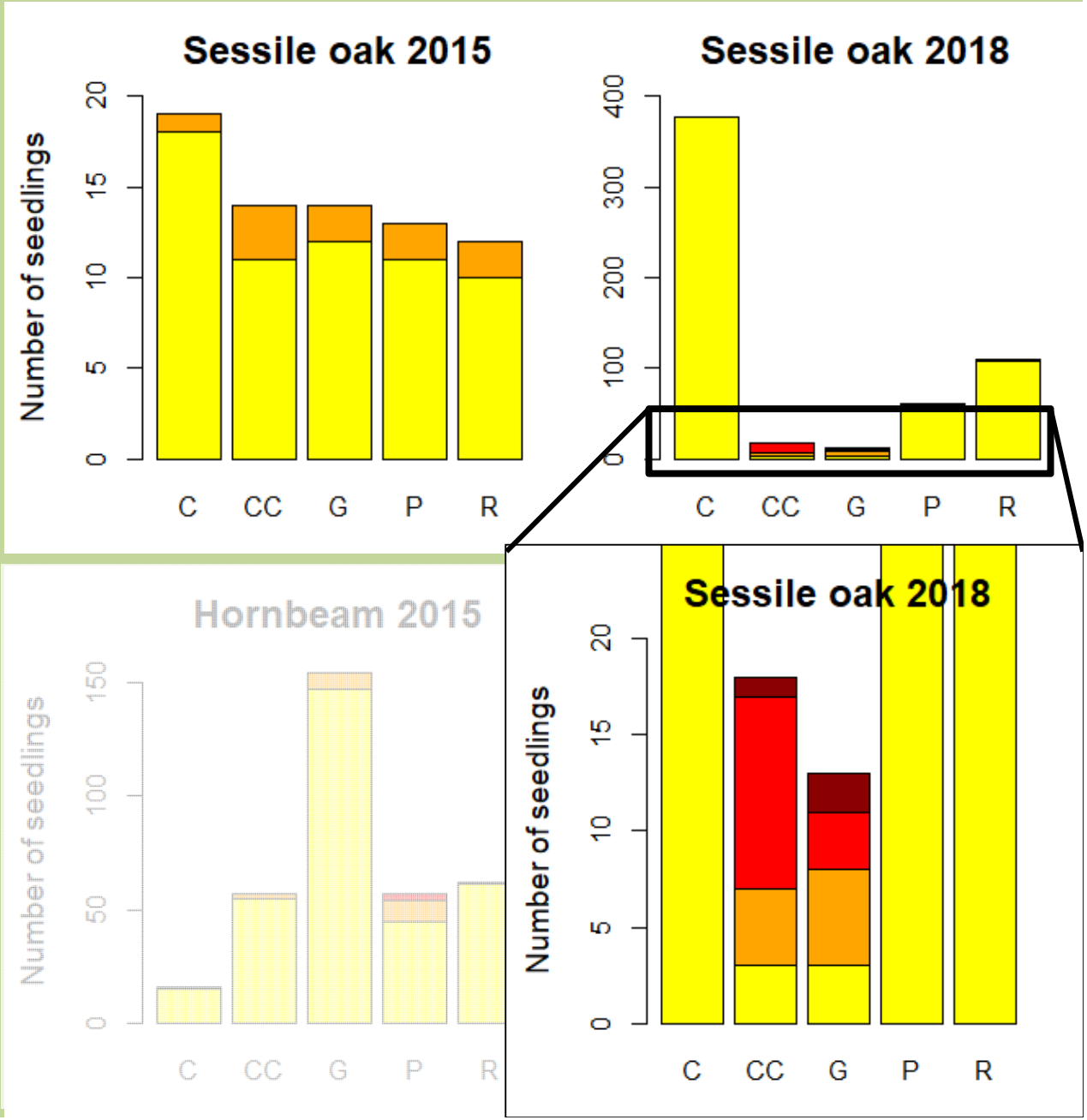
Results
2) Abundance of natural regeneration



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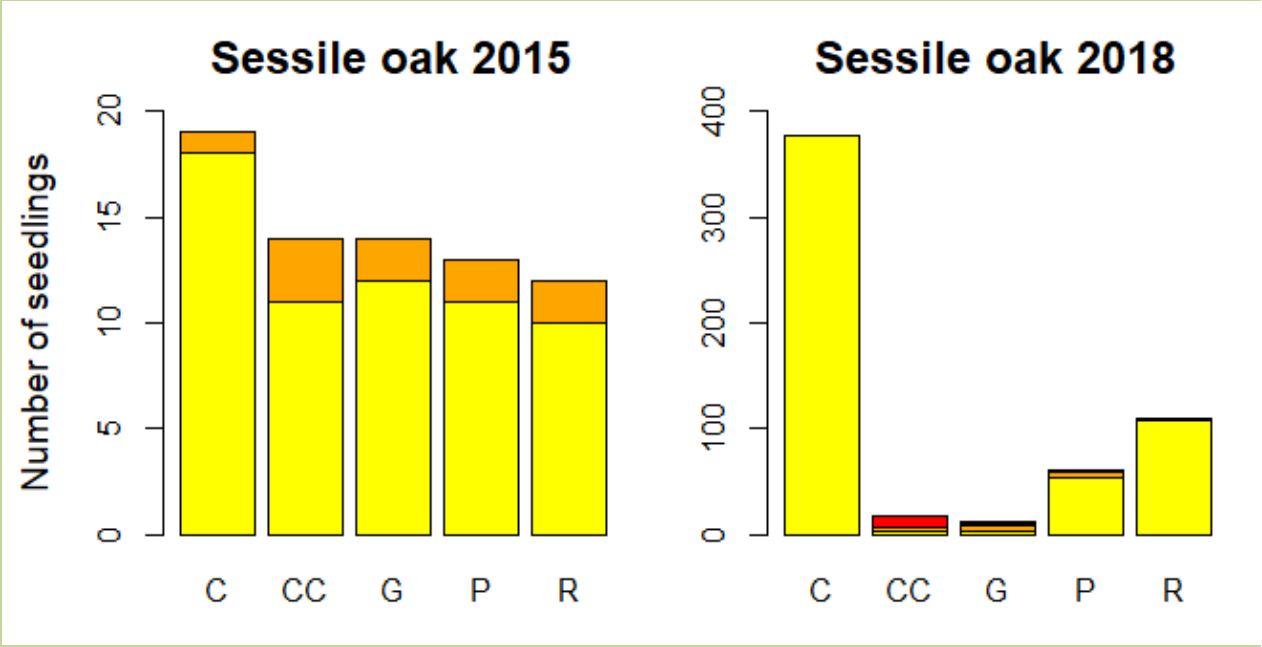

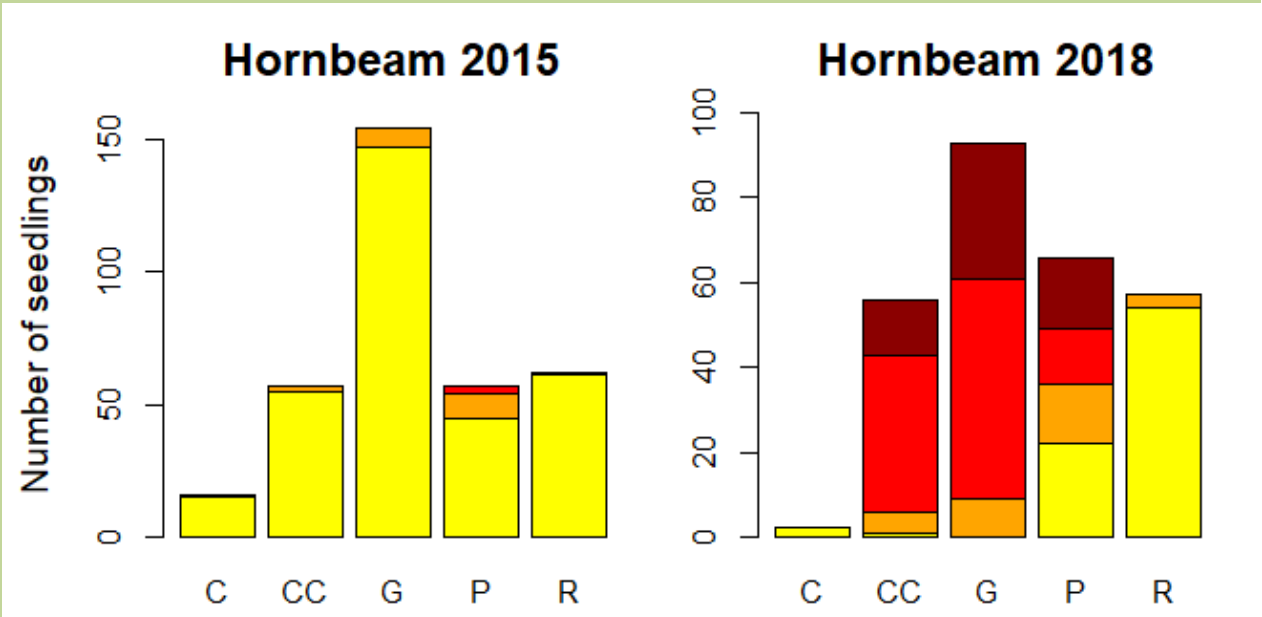

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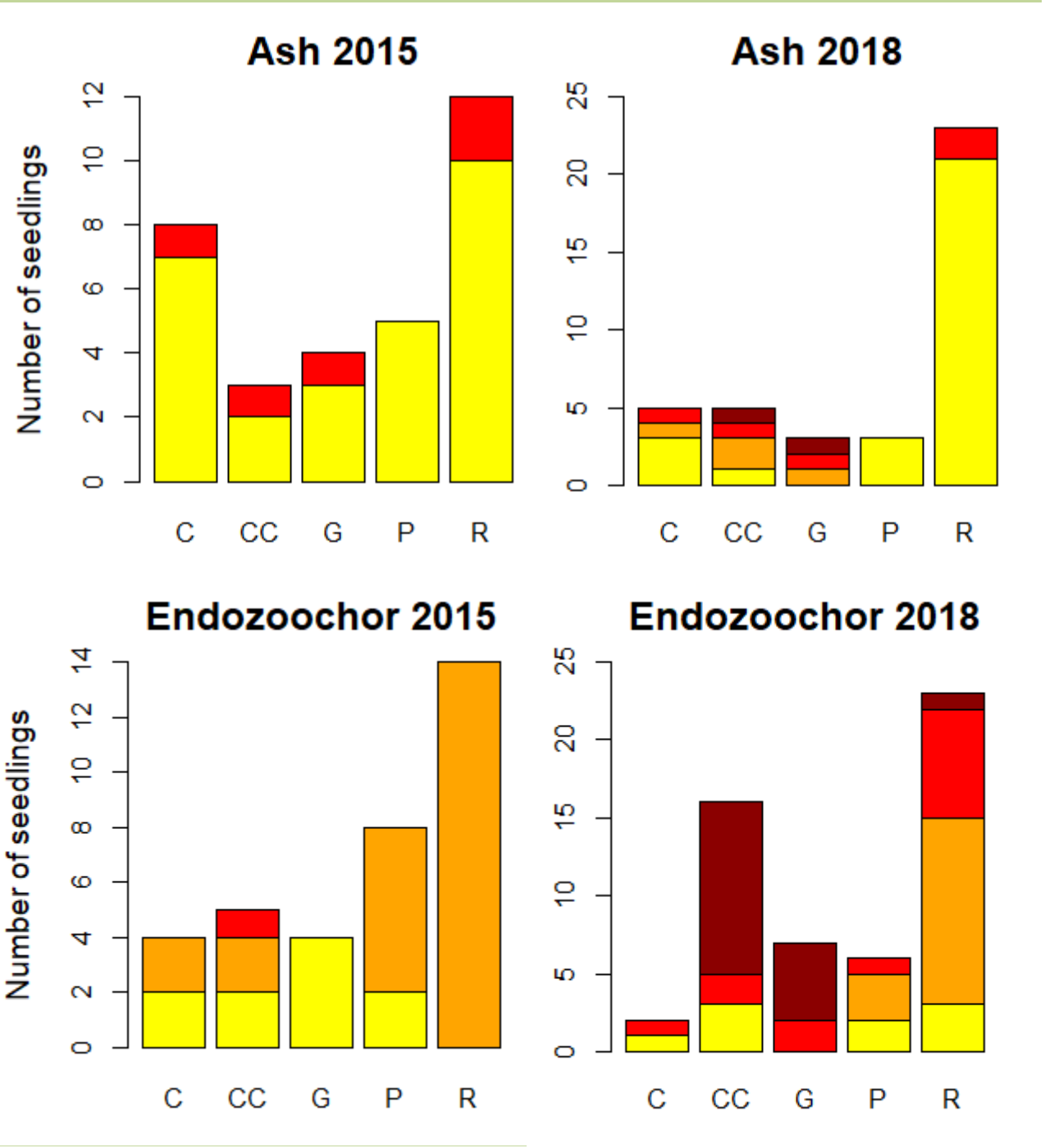

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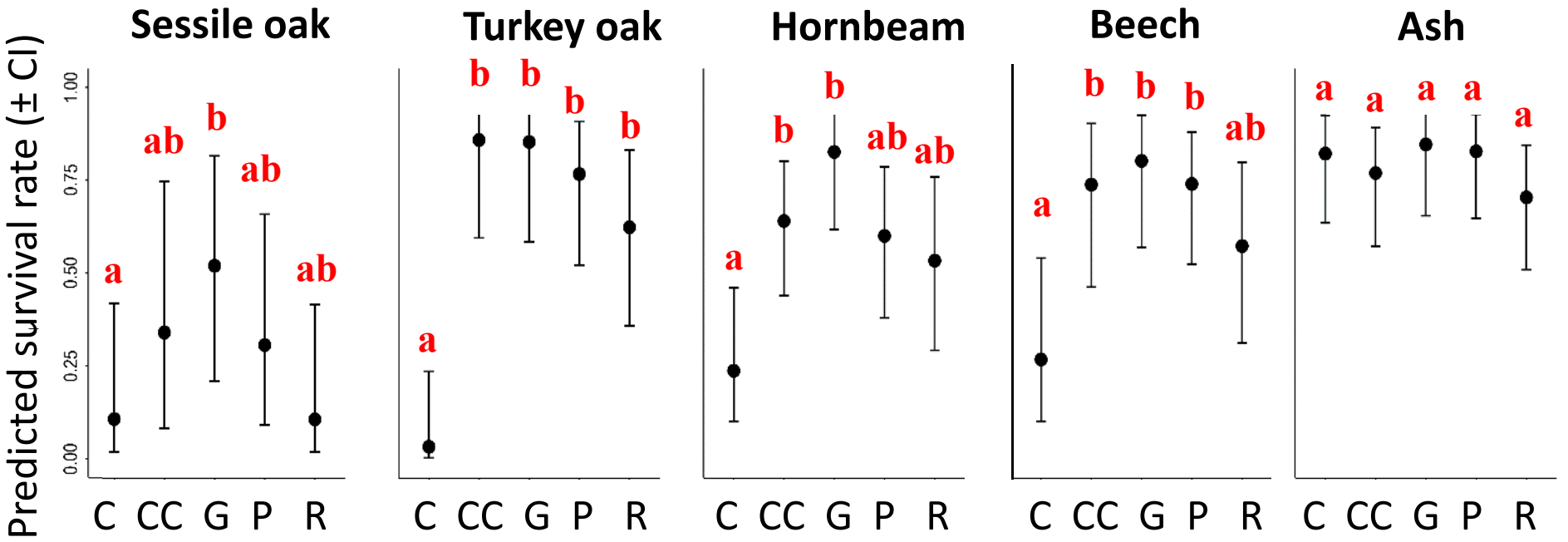
Results
3) Survival of the planted saplings



Sessile oak: only gap is significantly better than the closed stand

Turkey oak: all treatments are better than the C

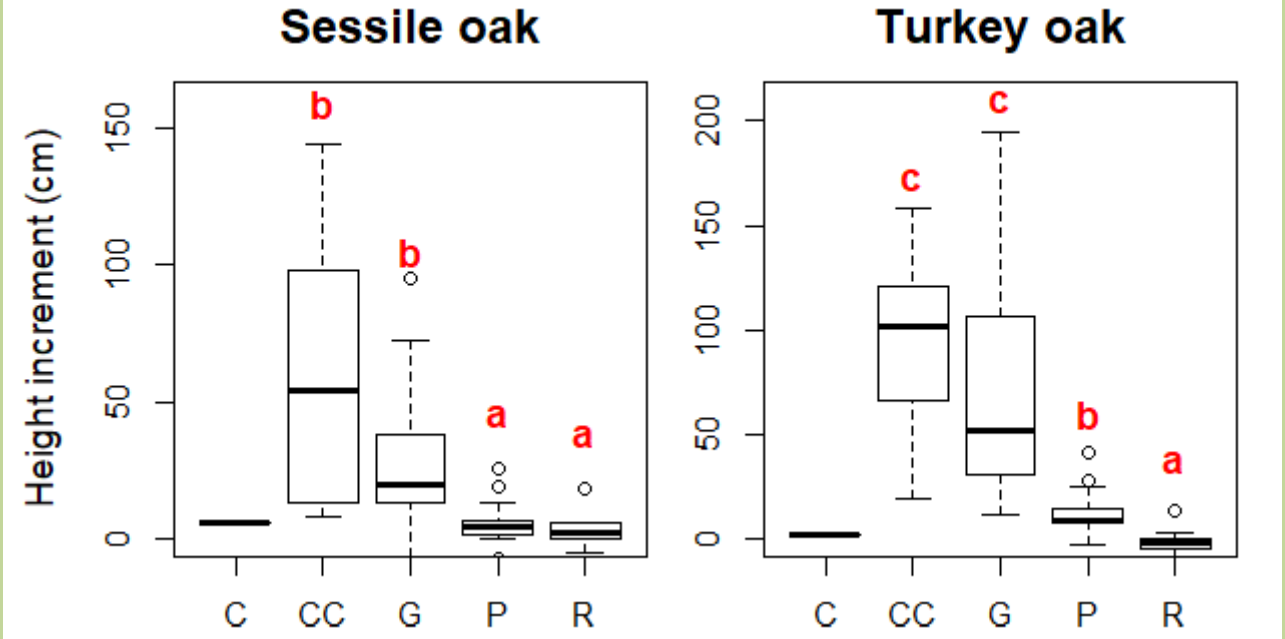
Hornbeam, beech: clear-cutting, gap is the best

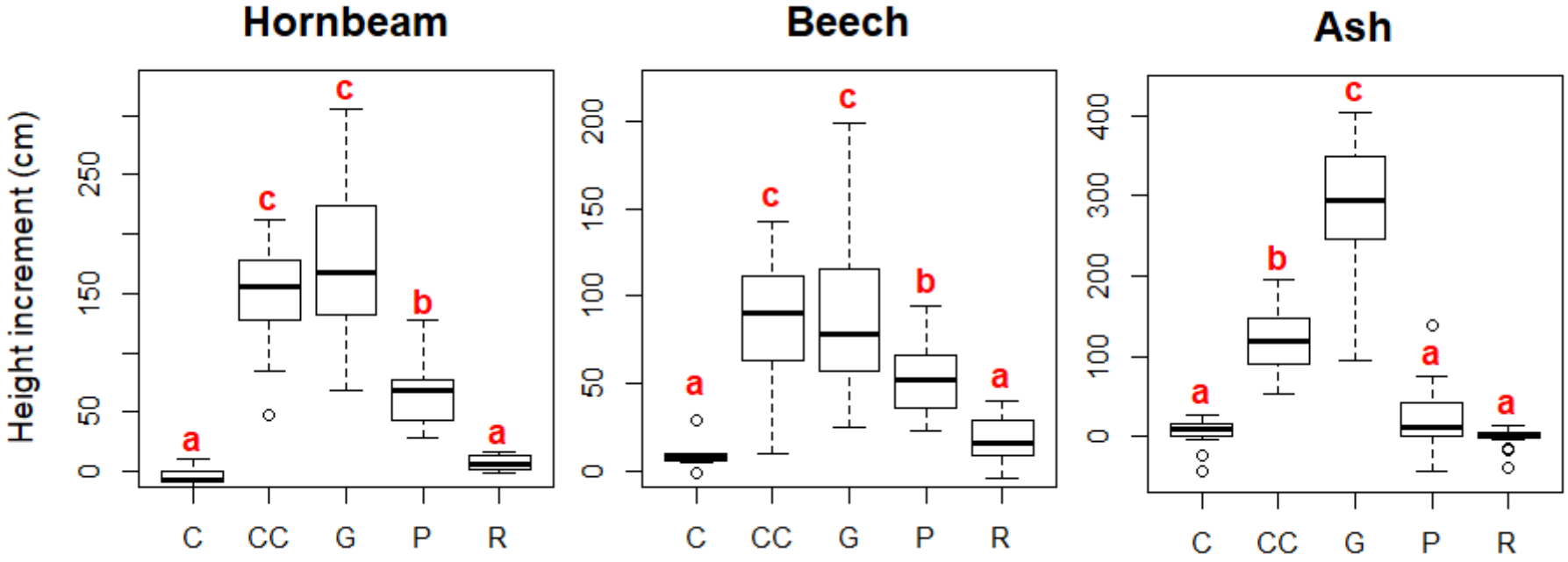
Ash: survives everywhere

C – Control
CC - Clear-cutting
G – Gap
P – Preaparation cutting
R – Retention tree group

Results
3) Height growth of the planted saplings

C – Control
CC - Clear-cutting
G – Gap
P – Preaparation cutting
R – Retention tree group





Conclusions – About the species

Species with different seed dispersal mechanisms respond differently to the treatments:

Oaks: presence detemined by acorn dispersal (hard to CC and G)

if they are present, they grow the best in CC and G

cannot survive in C

survives, but cannot grow in P an R

Hornbeam: establishes and survives in every treated sites (no disperal-limitation), best increment in G and CC

Beech: both G and CC are proper

Ash: most abundant in R (nude soil surface), but cannot grow there best growth in the gaps

Endozoochor species: establish the best in R, but grow the best in CC and G

Conclusions – About the treatments

All treated sites increase the survival of the saplings compared to C

Regeneration is the most successful in **gaps** and in **clear-cuttings** (enough light, soil moisture)

Gap gets more new acorns than in clear-cutting

In **preparation cutting** the success of regeneration is intermediate (intermediate light, soil moisture)

In **retention tree groups** many species can establish (free space, light), but it is not proper for growth (dry)

In **clear-cutting and retention tree group** the species richness began to increase: favourable for admixing species, but some of them are non-forest species

Practical considerations for management

Continouos cover forestry is at least as suitable for forest regeneration as rotation forestry

Cutting should be done after masting years to have acorns

Saplings present during the cutting should be preserved from disturbances and browsing

Species of mesic forests (hornbeam, beech) profit more from the conditions of gaps than oaks → oaks must be helped

Future plans -
The Pilis Gap Experiment

Focus: continuous cover forestry

What kind of gaps are the most favourable

- to maintain the forest site conditions,
- to enhance the regeneration,
- to preserve forest biodiversity,

during forest management?

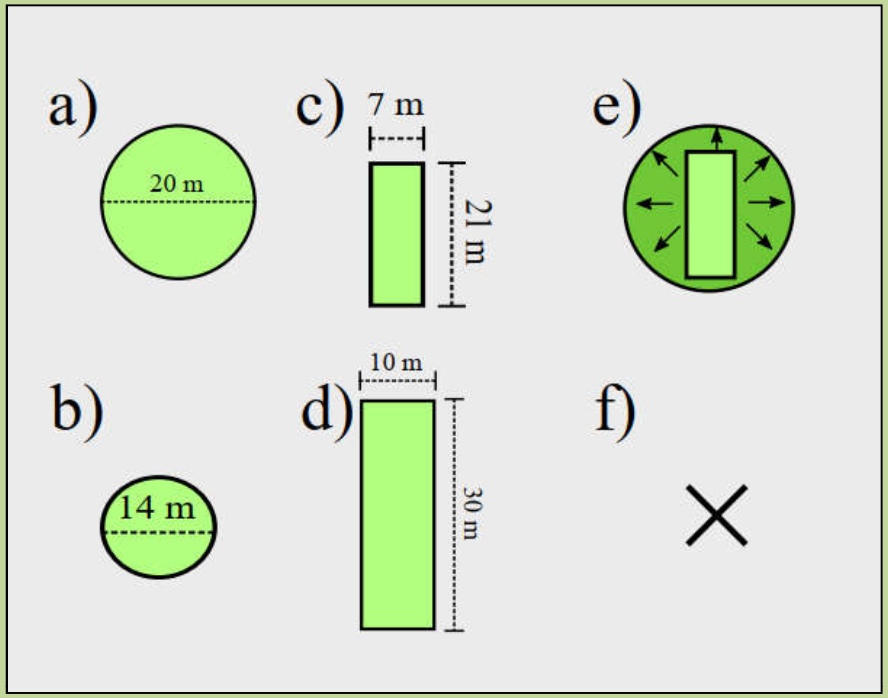
Experimental design

Pilis Mountains, Hosszú-hill

90 year old oak-hornbeam forest

6 treatments, 6 replicates

Interventions: 2018-19 winter



Regeneration survey:

- acorn counting
- species richness and abundance of the natural regeneration
- growth of individual sessile oak seedlings

Acknowledgement

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