The effect of different forestry treatments on multi-taxon biodiversity in a sessile oak-hornbeam forest: Pilis Forestry System Experiment

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CENTRE FOR ECOLOGICAL RESEARCH

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ÖK ÖBI
Forest Ecology Research Group

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Motivation

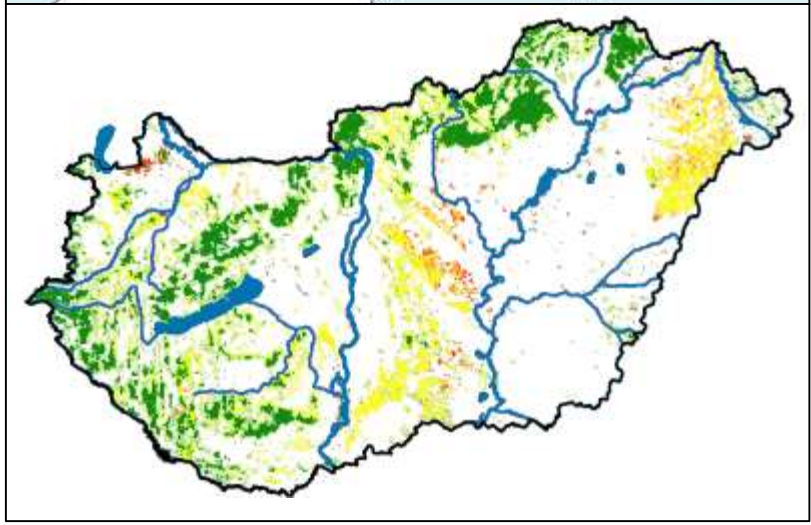
Necessity of the integration of timber production and conservation in forest mangement in Hungary

Forest cover in Hungary: ~21%

- Managed forests: 96%
- Protected + Natura2000 (management restrictions): 44%

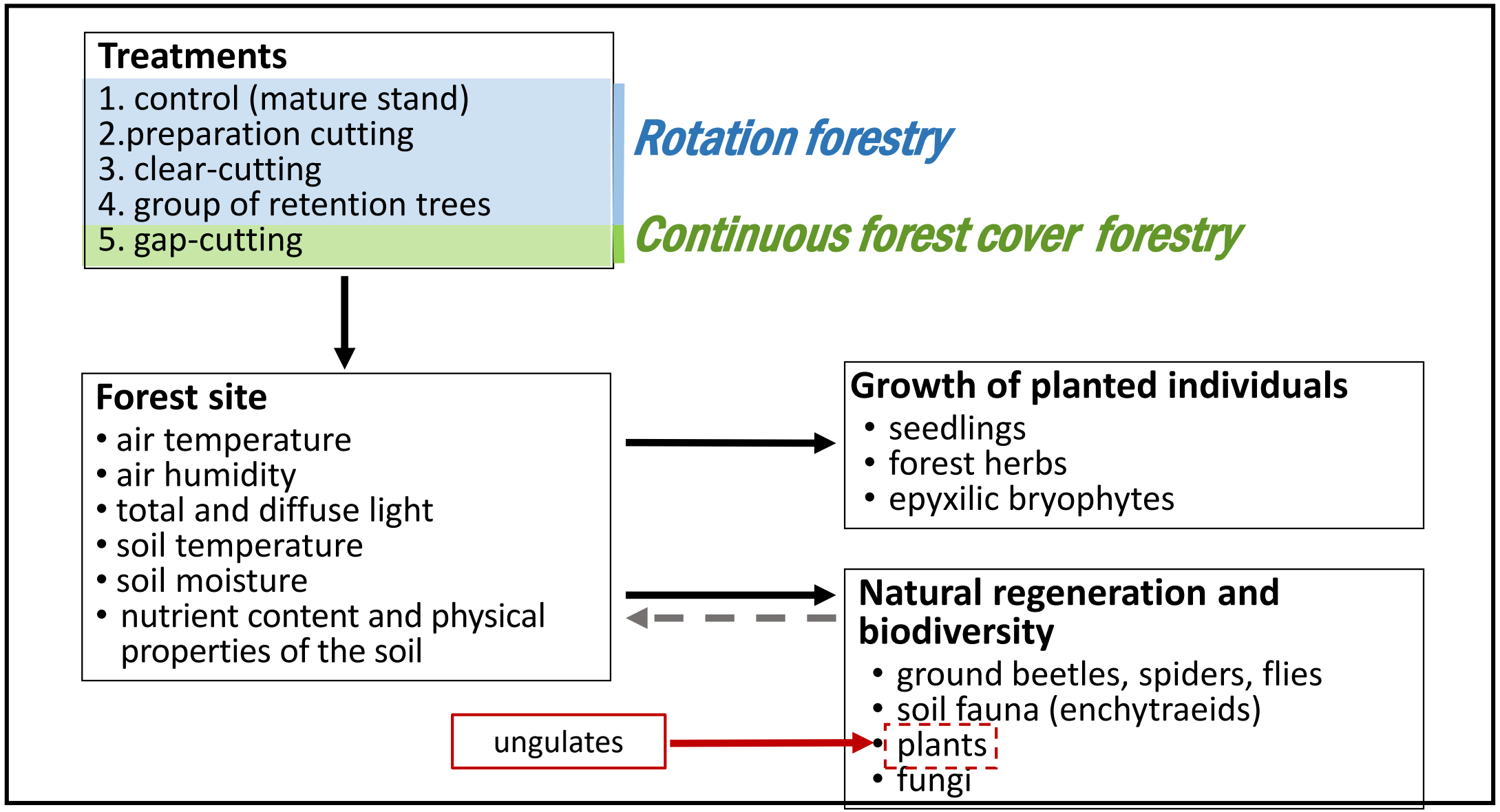
Applied silvicultural systems:

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



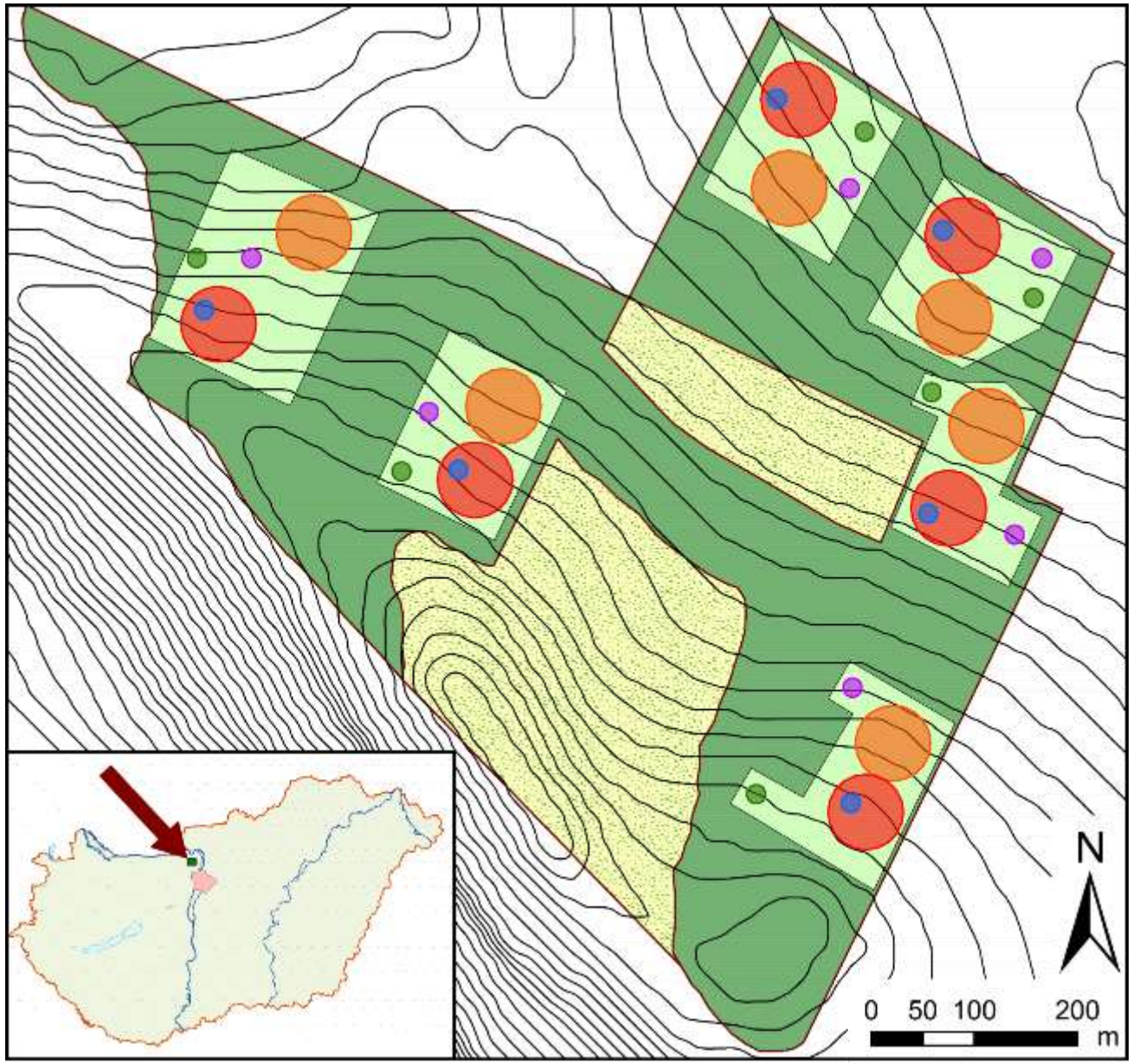
Important to study the relationships between forest management and biodiversity

Framework of Pilis Foresty Systems Experiment



Experimental design

- 5 treatments:
  - preparation cutting (d=80 m)
  - gap cutting (d=20 m)
  - clear-cutting (d=80 m)
  - retention tree group (d=20 m)
  - control
- 6 replicates – complete block design
- BACI (Before-After-Control-Impact): all measurements started in 2014



Control | Clear-cutting | Gap-cutting | Preparation cutting | Retention tree group

Relative diffuse light 2016

2%[a] | 81%[b] | 35%[c] | 20%[d] | 17%[d]





2015





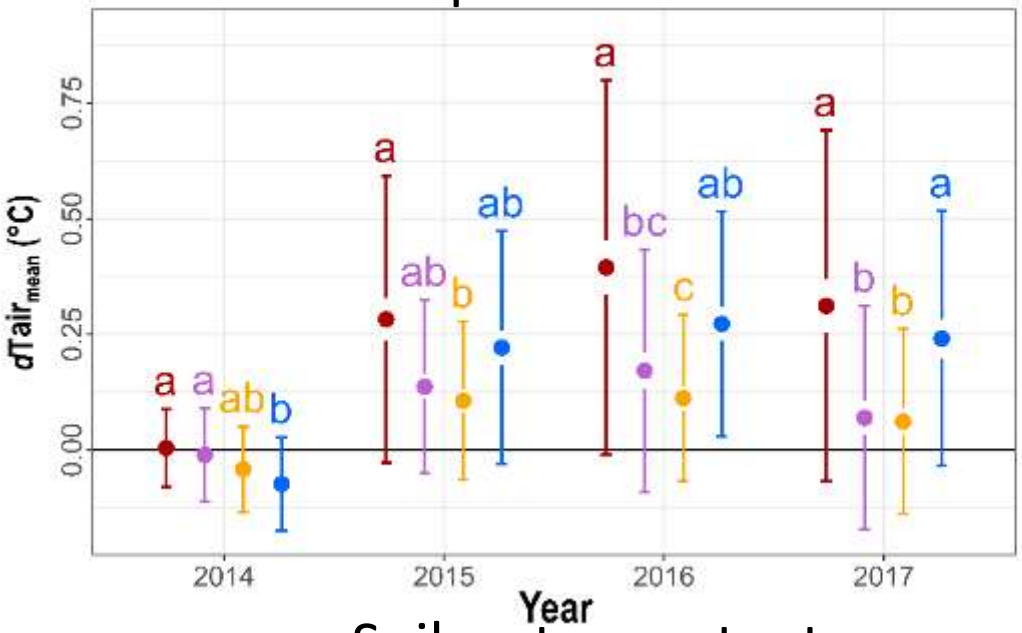
2019



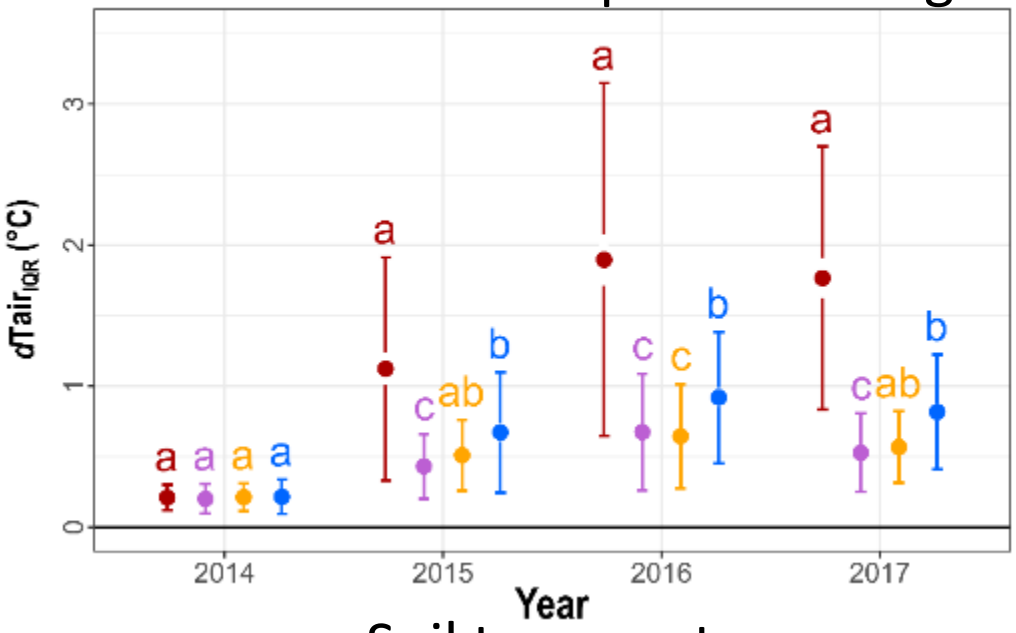


Microclimate

Air temperature mean

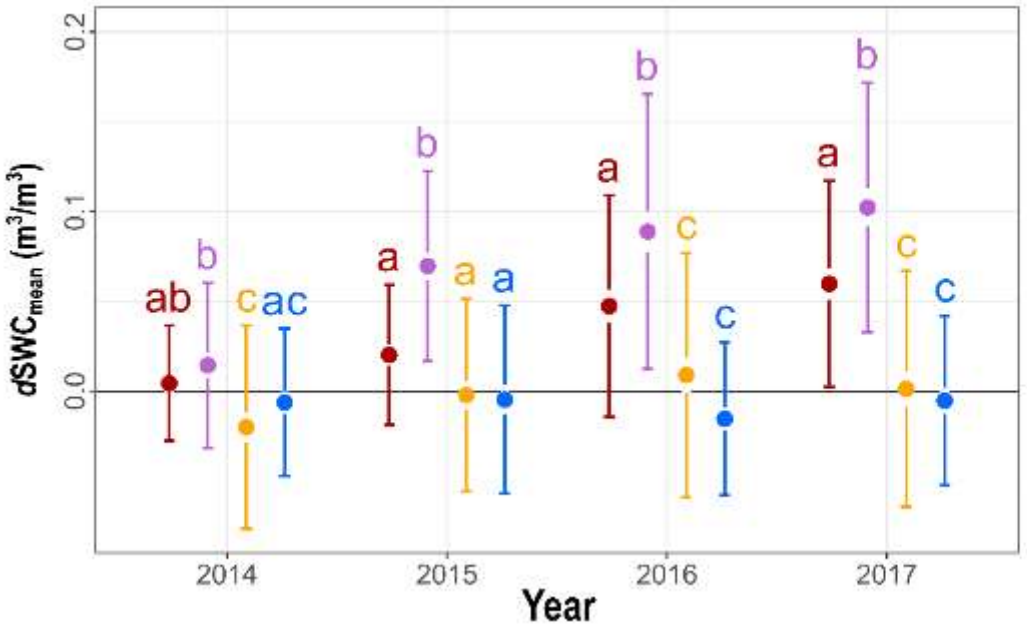


Air temperature range

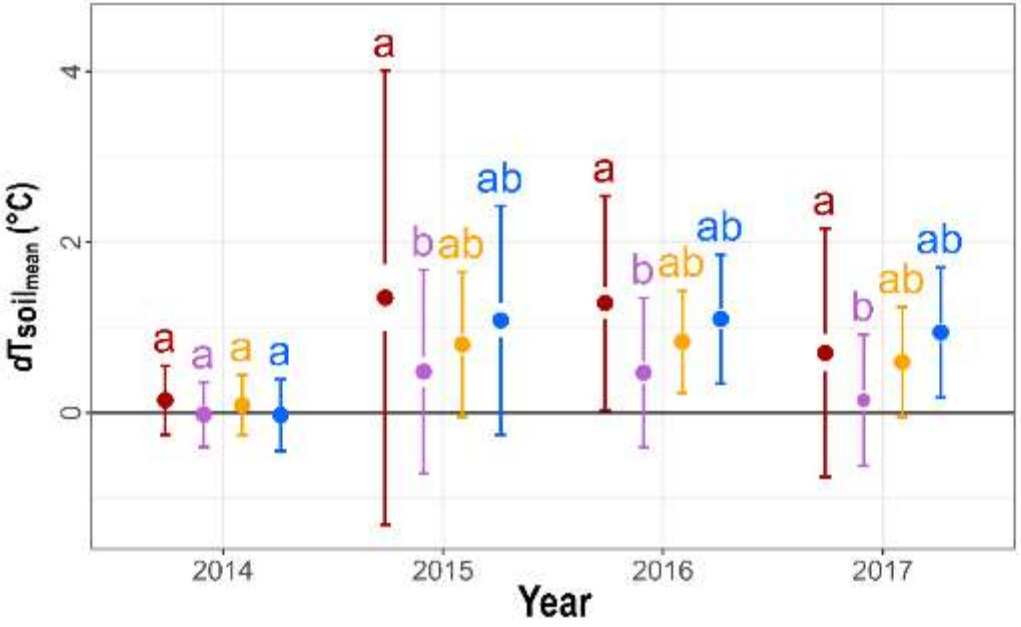


Treatment
- Clear-cutting
- Gap-cutting
- Preparation cutting
- Retention tree group

Soil water content



Soil temperature



Kovács et al. 2020, Ecological Applications, 30(2): e02043. https://doi.org/10.1002/eap.2043

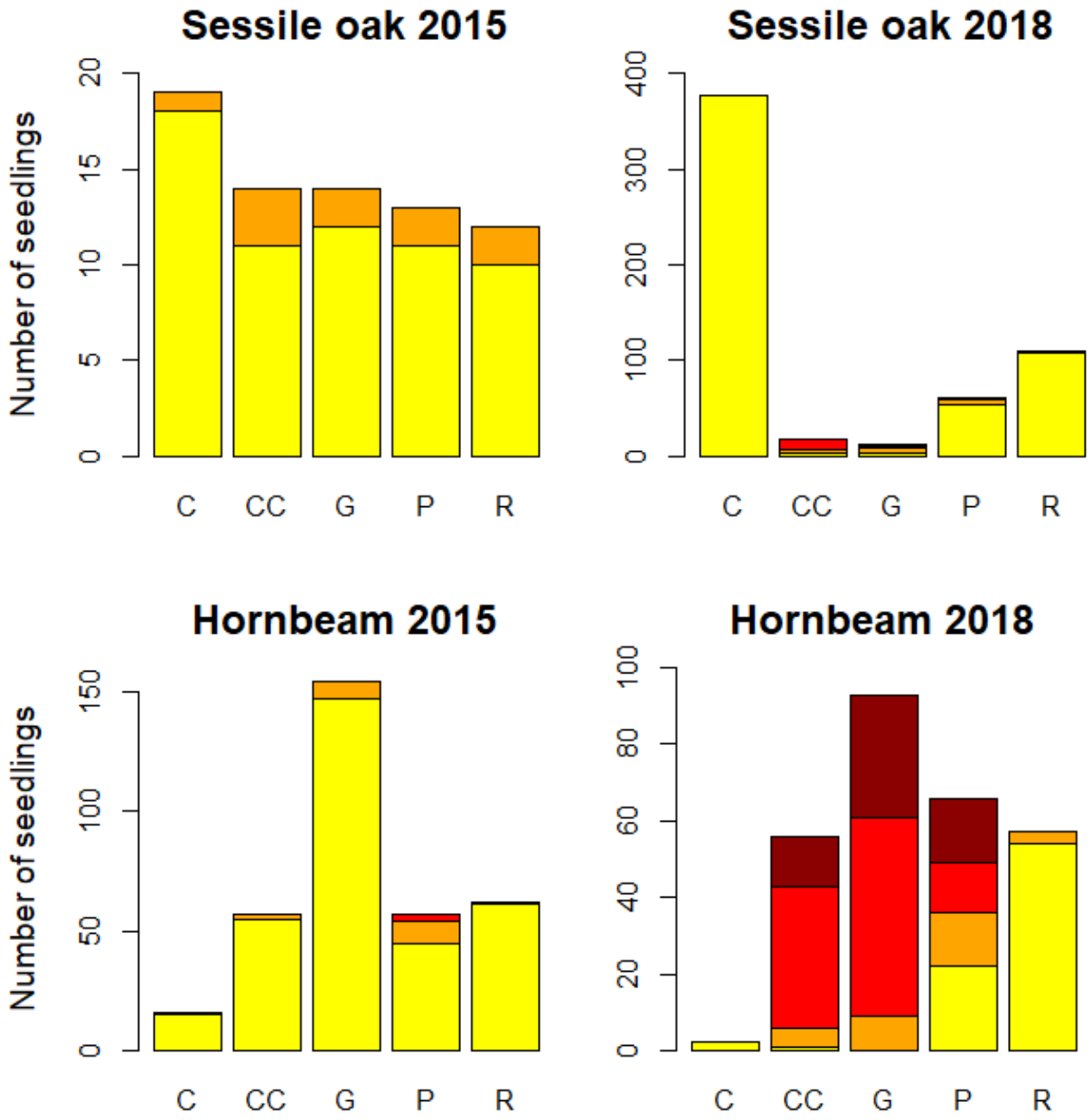
Natural regeneration

Size categories:

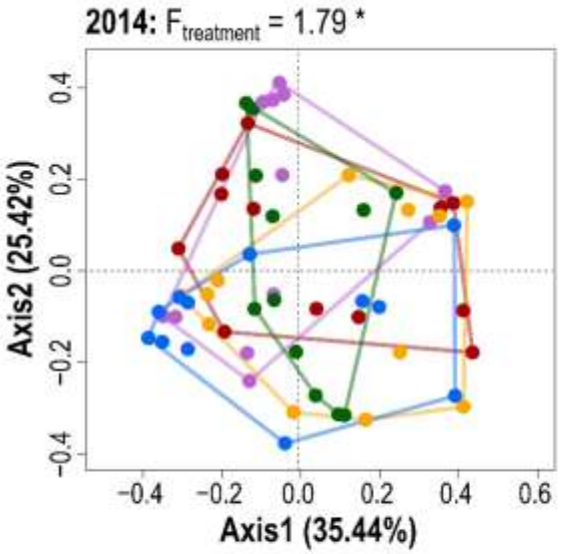
- 0-20 cm
- 20-50 cm
- 50-130 cm
- >130 cm

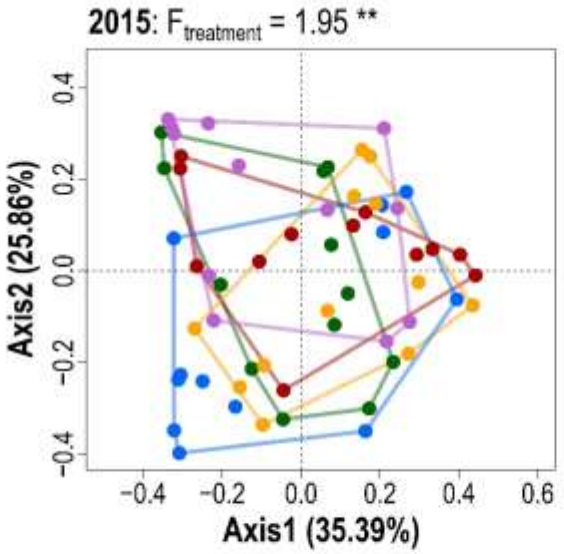
C – Control
CC - Clear-cutting
G – Gap
P – Preaparation cutting
R – Retention tree group

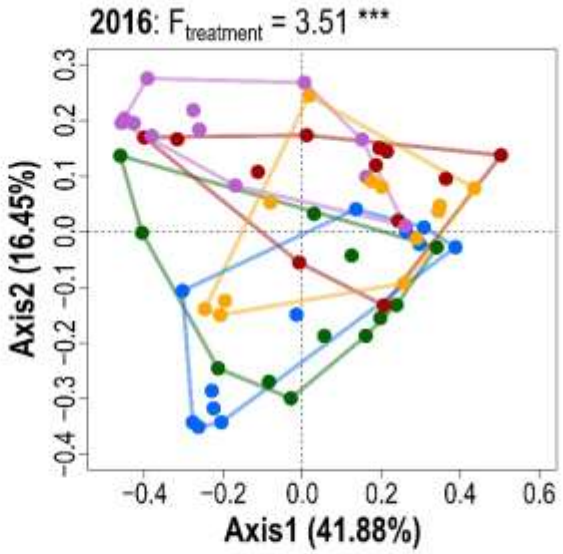
Tinya et al. 2020. Forest Ecology and Management, 433: 720-728.
https://doi.org/10.1016/j.foreco.2018.11.051

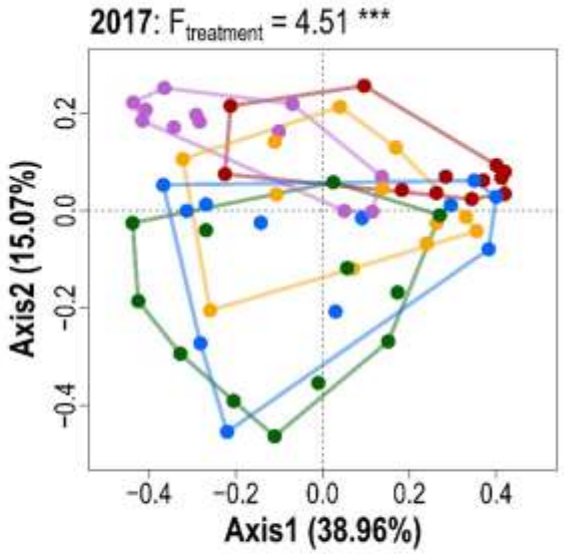


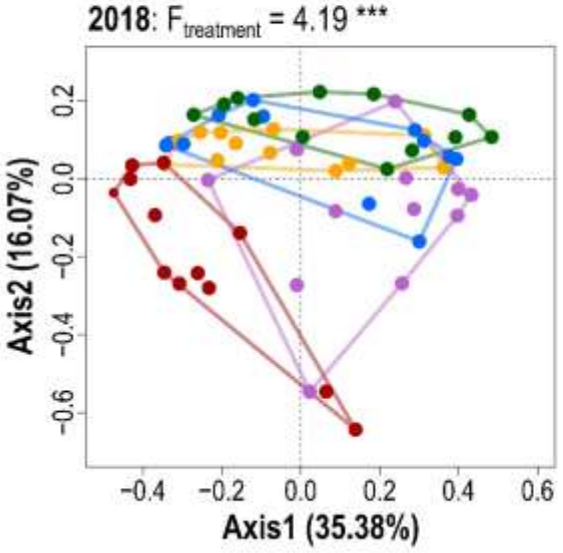
Understory

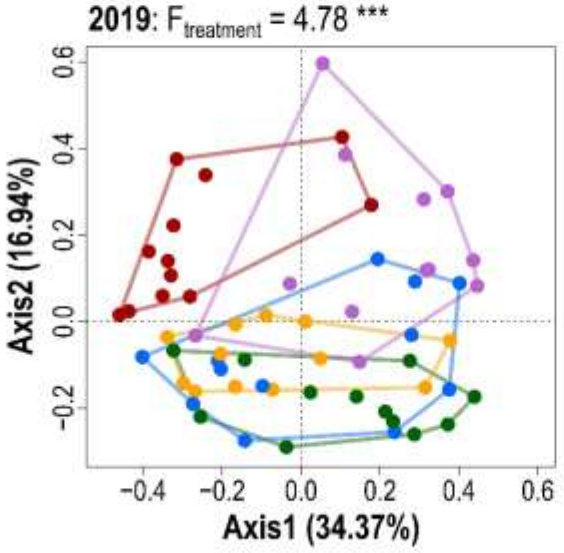


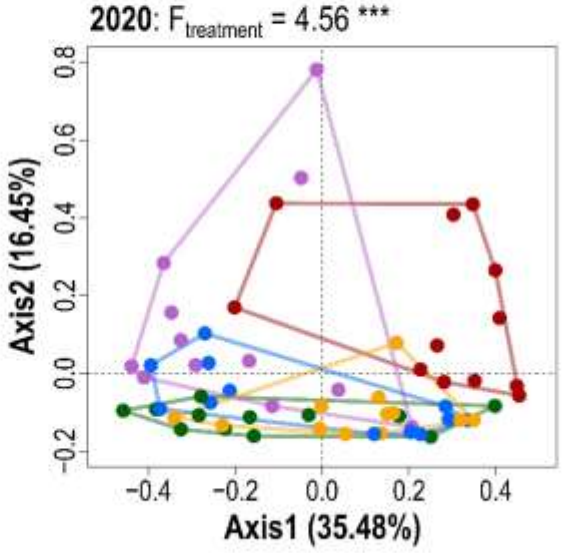












Treatment types:

- Control
- Clear-cutting
- Gap-cutting
- Partial cutting
- Retention tree group

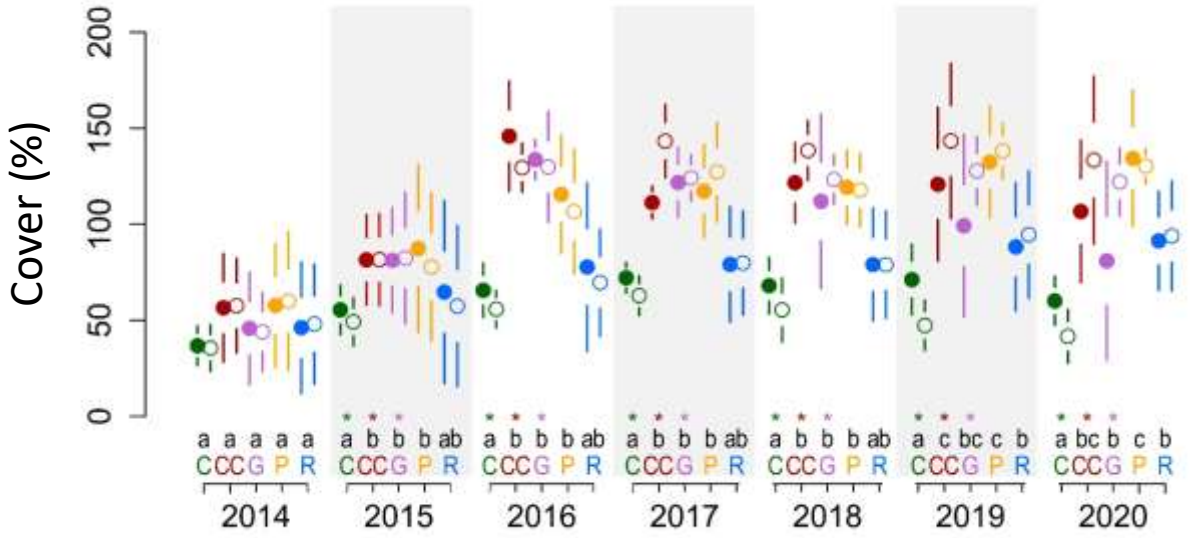
Significance codes:

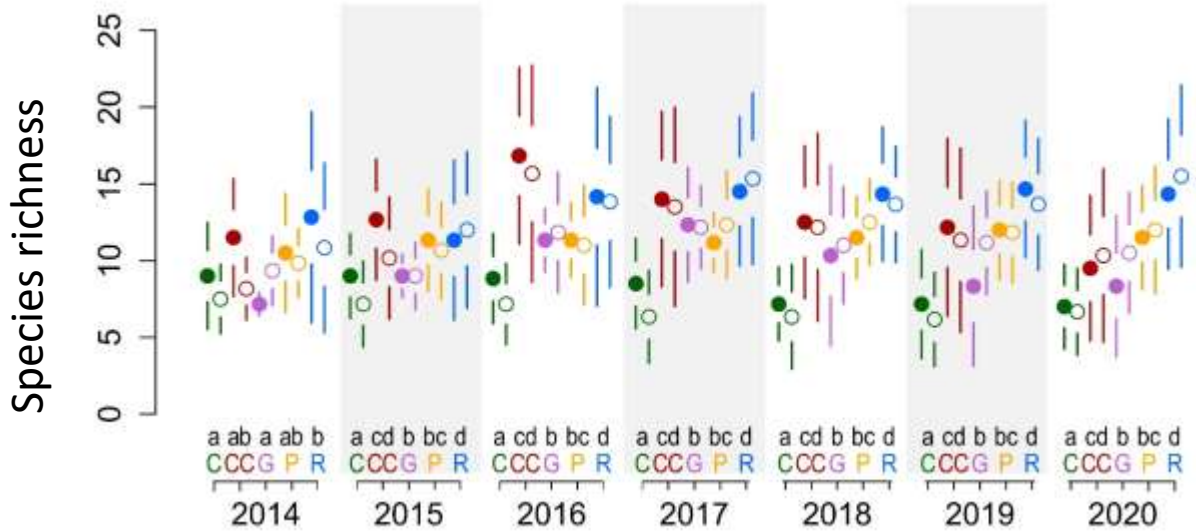
*** ≤ 0.001
** ≤ 0.01
* ≤ 0.05

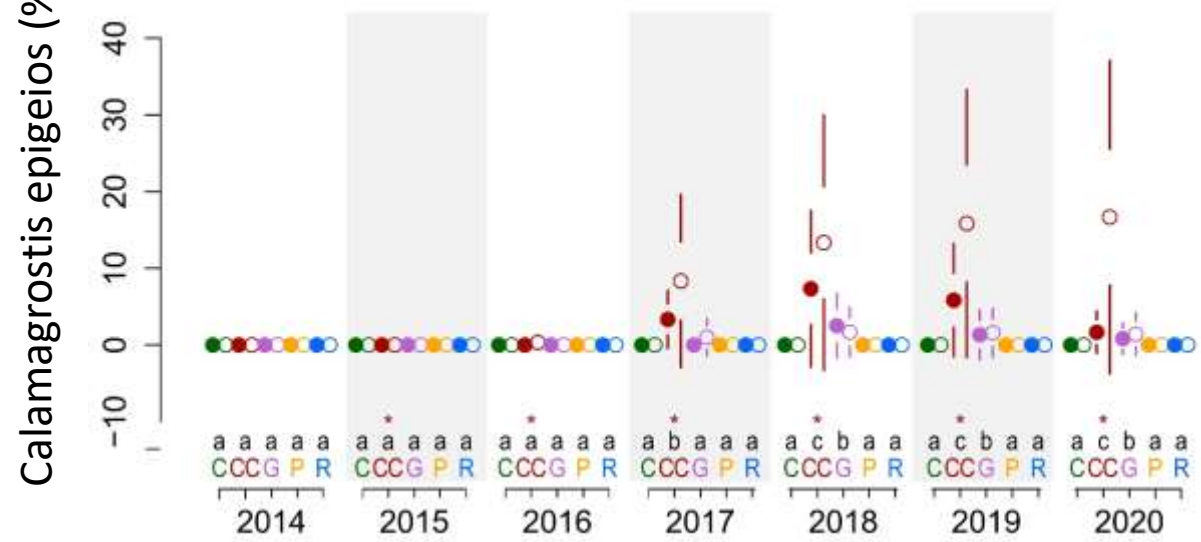
Réka Aszalós in prep.

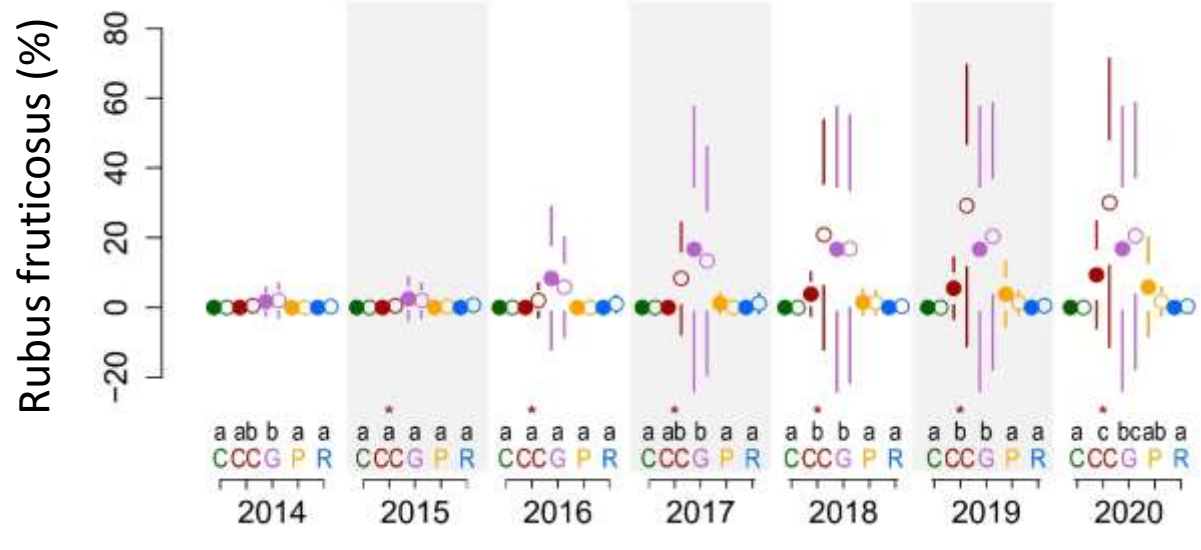
C–Control CC–Clear-cutting G–Gap-cutting P–Preparation cutting
R–Retention tree group

Full-fenced Empty-unfenced





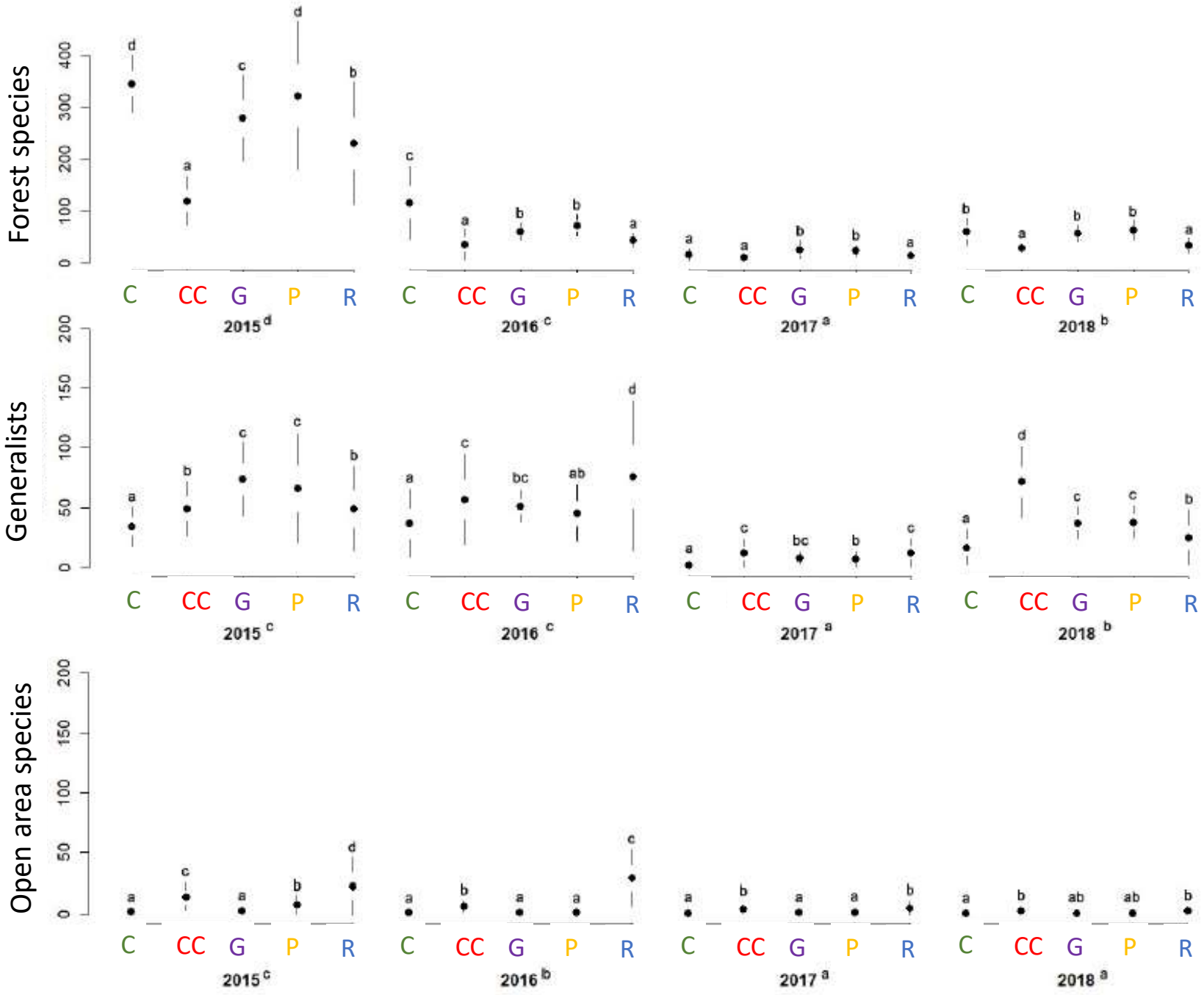




Carabidae - ground beetles
Abundance of functional groups

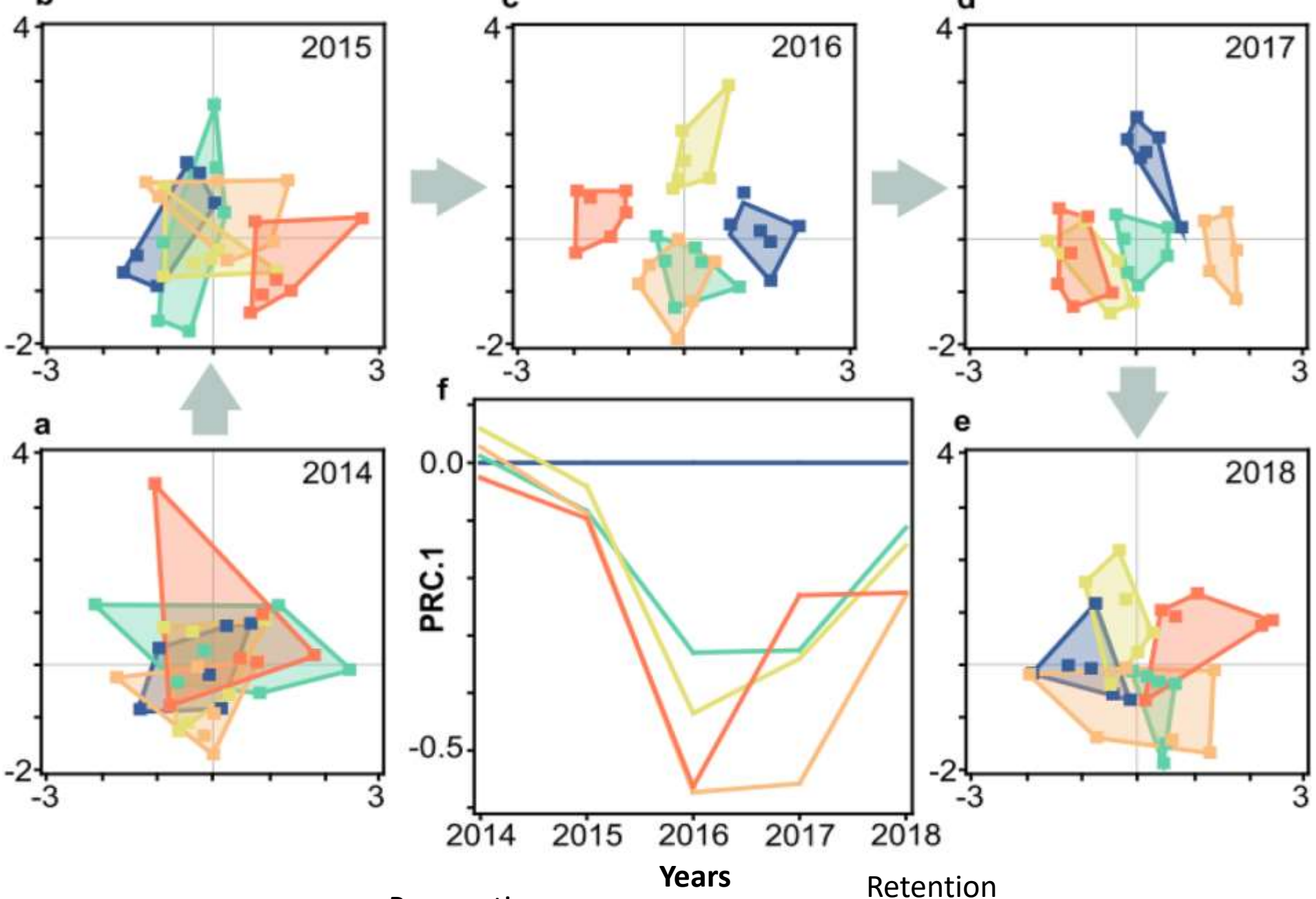
C – Control
CC – Clear-cutting
G – Gap-cutting
P – Preparation cutting
R – Retention tree group

Elek et al. 2022. Ecological Applications 32(1): e02460,
https://doi.org/10.1002/eap.2460



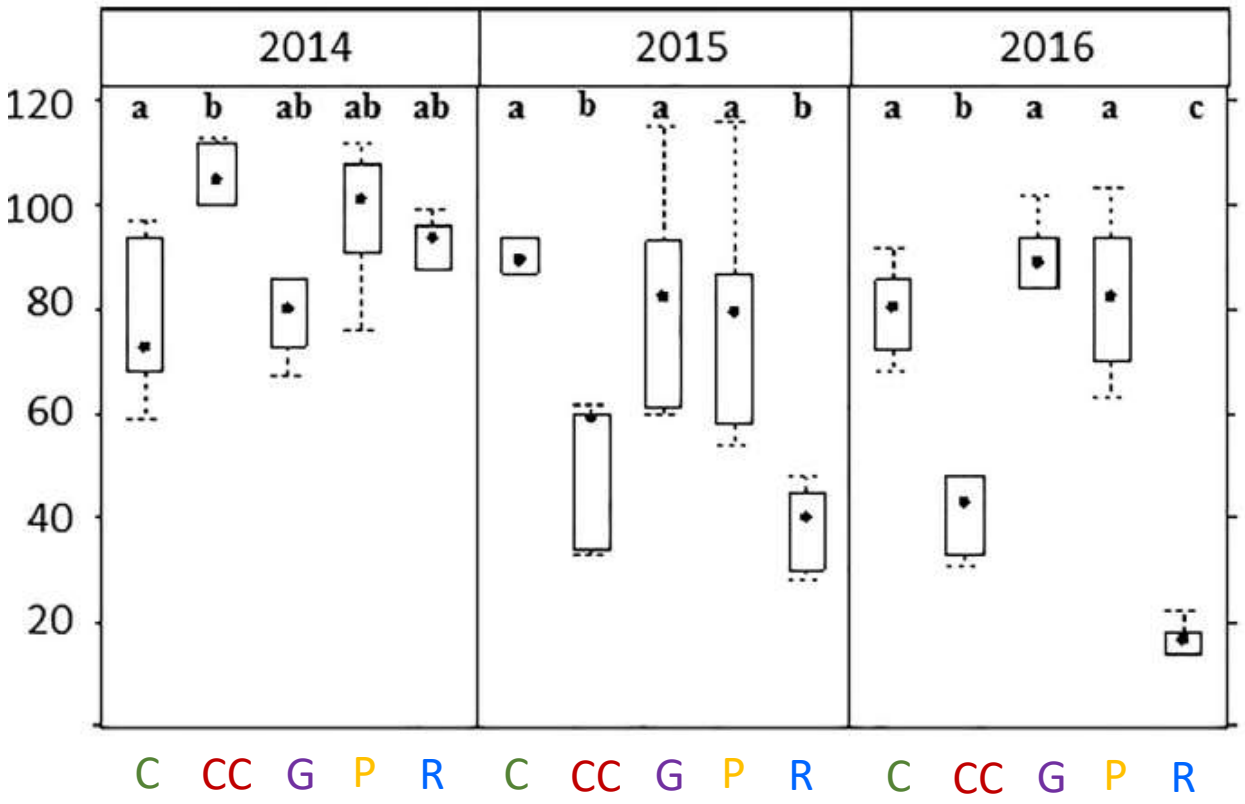
Spiders
Species composition

Samu et al. 2021. Scientific Reports 11: 20520
https://doi.org/10.1038/s41598-021-99884-8

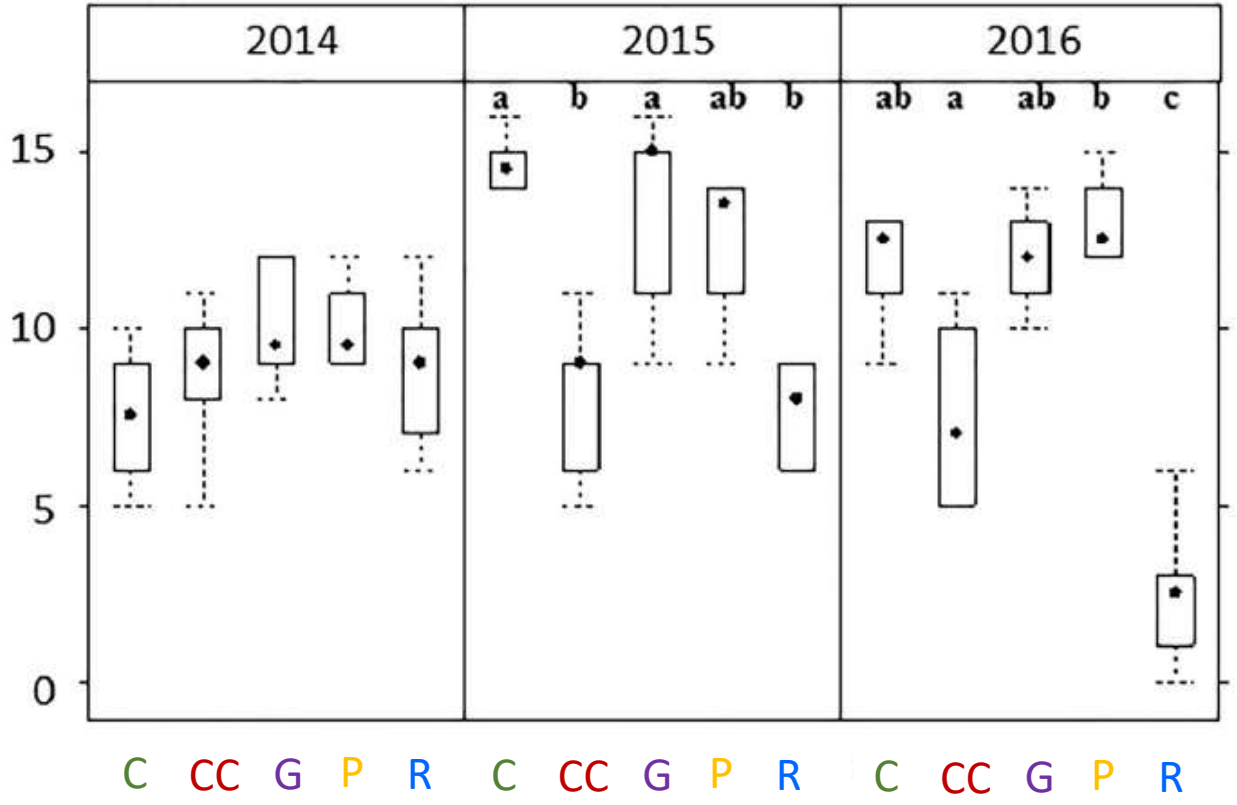


Enchytraeid worms

Abundance



Species richness

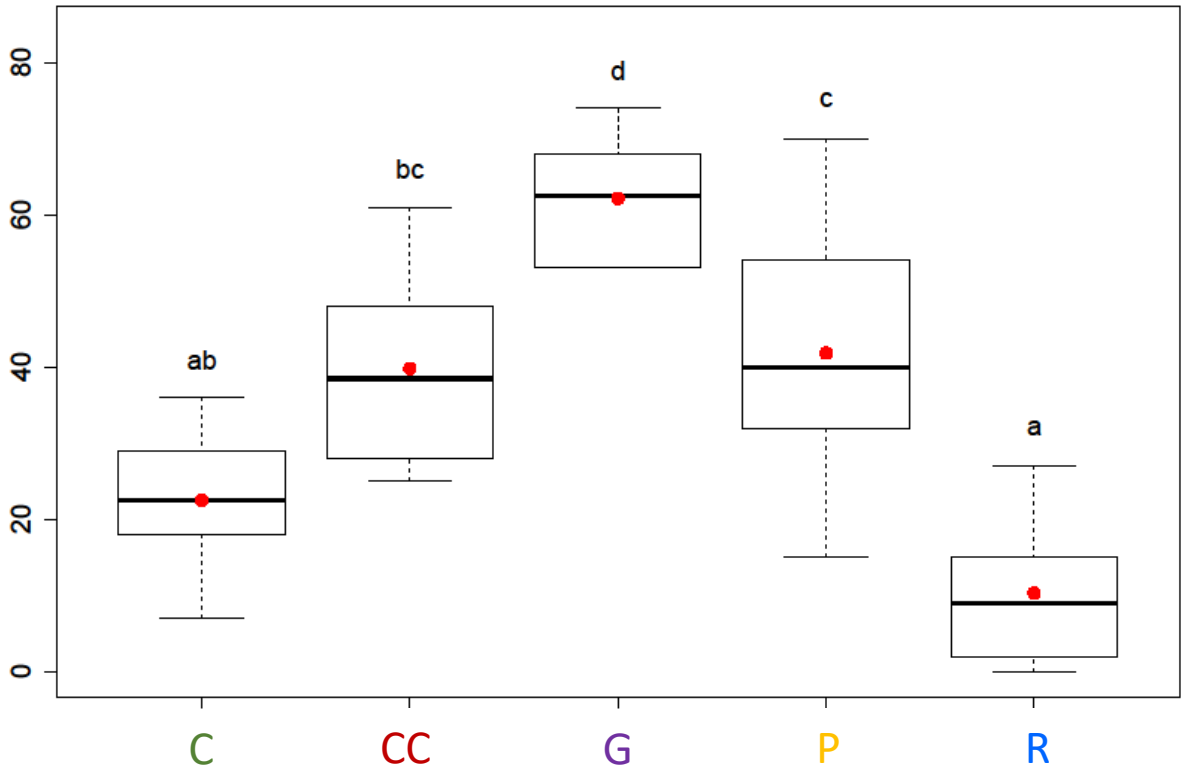


C – Control
CC – Clear-cutting
G – Gap-cutting
P – Preparation cutting
R – Retention tree group

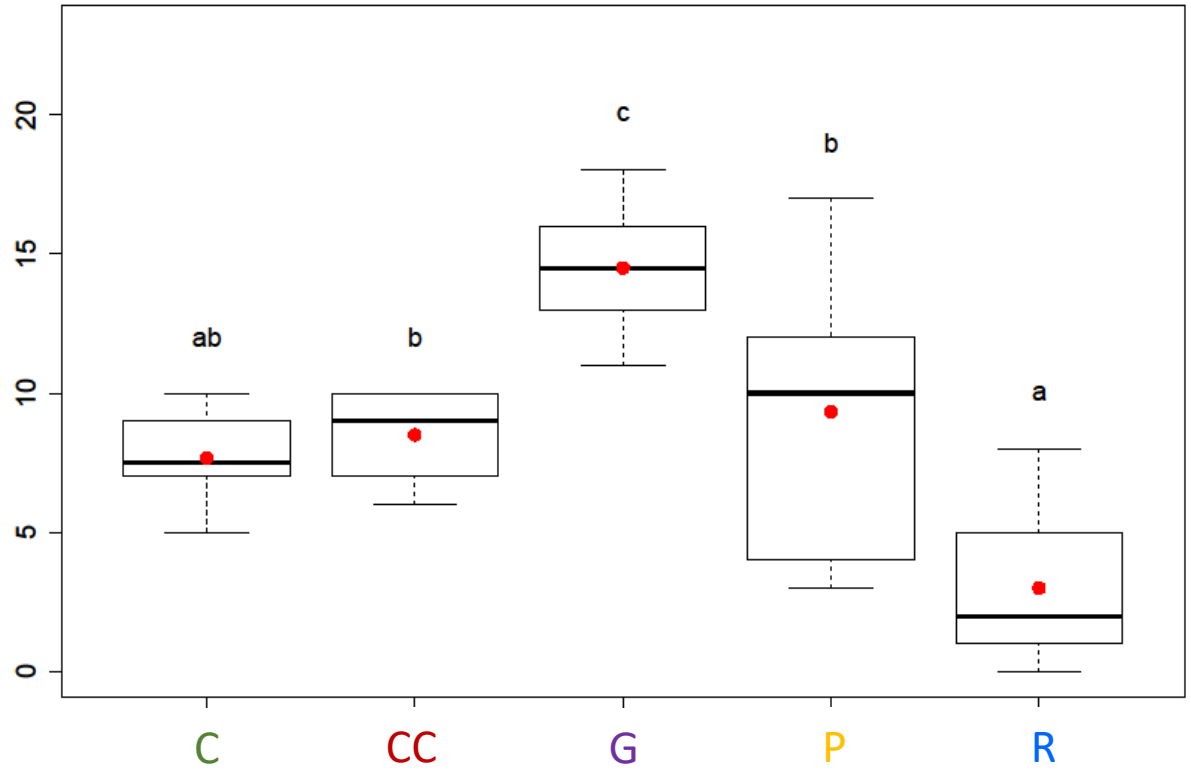
Boros et al. 2019. Applied Soil Ecology 136:106-115
https://doi.org/10.1016/j.apsoil.2018.12.018

Crane flies (Tipulidae) 2017

Abundance



Species richness

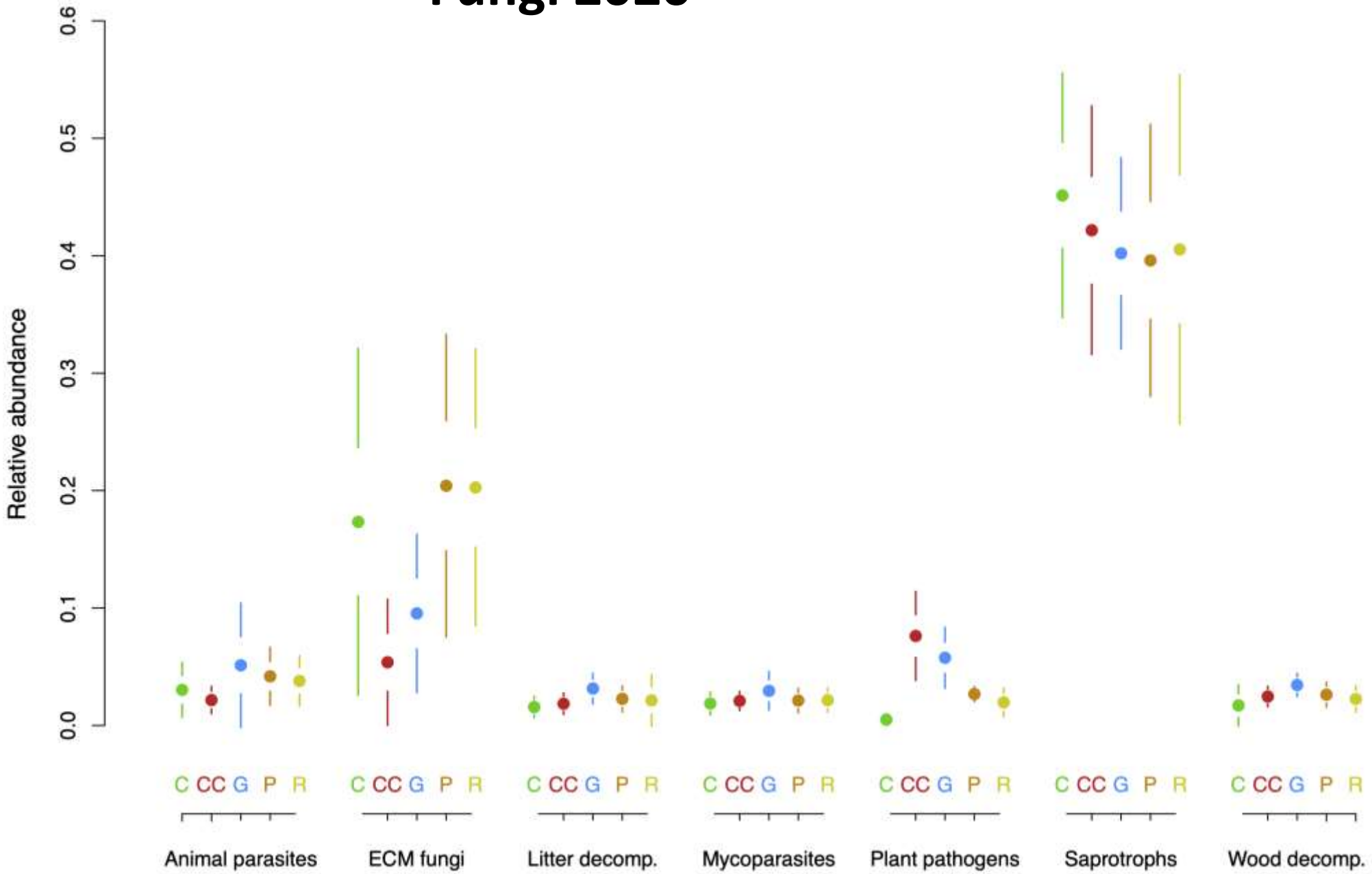


C – Control
CC – Clear-cutting
G – Gap-cutting
P – Preparation cutting
R – Retention tree group

Zoltán Soltész in prep.

Fungi 2020

József Geml in prep.



Conclusions

- Clear-cutting: extreme microclimate, good for regeneration, non-forest understory species, unfavorable for soil organisms, non-forest carabids, fungi composition changed.
- Gap: balanced microclimate, soil moisture increment, good for regeneration, light-flexible forest species in understory, favorable for soil organisms, forest carabids, fungi composition changed.
- Peparation cutting: Microclimate similar to control, moderate regeneration, increased understory cover with forest species, animal and fungi community similar to control.
- Retention tree group: warmer and drier micrclimate, low soil moisture, no regeneration, understory similar to control more species from forest edges, unfavorable for soil organisms, non-forest carabids.

- Treatment of continuous cover forestry as gap-cutting, partial cutting, thinning provide regeneration but more favorable for microclimate and forest biodiversity than treatment of rotation forestry.
- In case of rotation forestry large retention tree groups are necessary to compansate the effect of final cuttings.
- Soil organisms were the most sensitive groups
- Composition and functional groups better indicators than general species richness or abundance.







Thank you for your attention!

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