The effects of forestry treatments on microclimate, regeneration and biodiversity

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Abstract

There is a paradigm shift in Central Europe from the traditional forestry systems towards continuous cover forestry that provides a diversification of possible management practices. In a mature, temperate sessile oak-hornbeam forest in Northern Hungary, four different forestry treatments were modeled within the framework of an open-field forestry experiment, which belong to rotation system (preparation cutting, clear-cutting, retention tree group) and selection forestry (gap creation). The effects of these treatments were studied on the community structure, diversity and abundance of vascular plants, enchytraeid worms, ground beetles and spiders. The experiment following a complete block design with six replicates was established in 2014, and the short-term (2014-2016) responses are summarized.

One of the major findings is that plant cover increased significantly in all treatments, especially in the gap and clear-cut. The abundance of worms decreased in some treatments belonging to the rotation system such as the clear-cut and retention tree group. The abundance of spiders and ground beetles were unaffected by treatments. The effect of treatments on the species richness of the various taxa were not revealed, except for worms, they were less species rich in the retention tree group. The treatments had a consistent effect on the species composition for all studied organism groups. Generally, plants and the immobile soil organisms showed the highest sensitivity to the altered microclimatic condition of the forestry treatments. Based on this short observation period we can conclude that fine scaled forestry treatments like gap creation had only moderate effect on forest site, which is favourable for conservational perspectives.

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Ódor, P., Boros, G., Samu, F., Aszalós, R., Tinya, F., Kovács, B., Elek, Z. 2017. The effects of forestry treatments on the community structure of different organism groups. Oral presentation. 1st International Conference of Community Ecology, 28-29 September 2017, Budapest, Hungary, Book of Abstracts, pp. 68.

Motivation

Necessity of the harmonization between timber production and conservation purposes

- Forest cover in Hungary: ~20%
 - Managed forests: 96%
 - Protected (management restrictions): 21%

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



Pilis project (2014-), Forestry experiment



Experimental design

- 75 yr old Quercus petraea Carpinus betulus stand
- 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
- Data analysis in 2016 (2 years after the treatments)





Design of a sampling unit



Forest site conditions

- Microclimate measurements for 72 hours in every month (March-November)
- 30 plots
 (5 Treatment × 6 Blocks)
- Indirect light measurements
- Soil Water Content pattern
- Soil variables (pH, C, N)



Relative Diffuse Light (2016)

F=55.843***



Air temperature difference (related to the control)



Soil conditions (related to the control)



Species richness difference (2016-2014)



Abundance difference (2016-2014)



Species composition 2016 (NMDS)



Summary

Forest site:

- *Temperature increment*: Clear-cutting, Gap-cutting, Retention tree group
- Daily temperature range increment: Clear-cutting
- Soil water content increment: Gap-cutting
- Soil temperature increment: All treatments (in gap less influential)

Organism groups:

- *Plants*: Low composition response, strong richness and abundance response (light effect)
- *Erythraeid worms*: Strong response for all variables (soil temperature and moisture)
- *Spiders*: High species composition response, no richness and abundance response
- Carabids: Intermediate response for all variables

Conclusions for management

- Continuous forest cover forestry is more favorable for conservation purposes than rotation (shelterwood) forestry system
- Consequences of this management are gaps and canopy openings
- Gaps provide favorable light conditions for regeneration, temperate microclimate, increased soil water content
- Preparation cutting had the most similar conditions to control
- In clear-cutting the retention tree group can compensate light effect and temperature range increment, but it can not compensate the increased temperature
- Sessile soil organisms are very sensitive to microclimatic changes resulted by forest management



Thank you for your attention

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