Coppice restoration as a means to sustainable biomass production and biodiversity conservation

Radim Matula

Department of Forest Botany, Dendrology and Geobiocoenology Faculty of Forestry and Wood Technology

Mendel University in Brno

What is coppicing?

- Coppiced forest is periodically cut and the trees are allowed to regrow from the cut stumps

- Coppiced forest provides a self-renewing source of wood allowing an indefinite number of crops of stems to be taken

- Traditionally contain coppiced trees (underwood) and scattered timber trees (standards).

- Regrowth from cut stump is very fast

- Rotation length ranges from 5 – 35 years

Coppicing - history

- The oldest silvicultural system known in most of the countries in the world (Matthews 1991; Fujimori 2001)

- Widespread throughout Europe until the second half of the 19th century

- Abandoned in response to a declining market for coppice products

- Most of the coppices converted to high forests

Coppicing abandonement
Impact on biodiversity

- Coppices represented conditions suitable for many plants, insects and birds requiring open woodland habitat
- Many previously common species become endangered or even extinct
- Documented shift from high diverse to low diverse mesic forest (Hedl 2010)

Coppicing
Renewed interest

- to re-create habitats for endengered species
- increasing demand for woody biomass
- rising firewood prices

→ Coppice restoration

Coppice restoration

Constraints

- Information on coppice management only from documents from before 1930s
- Great deal of the knowledge on coppice management lost
- Management can not be targeted to desired species or communities
- Trees in stands for potential coppice restoration to old to resprout

Implications for research

Need for field experiments in combination with comparable studies from countries where active coppicing is still practiced

Experimental plots of restored coppices in the Czech Republic

Study of active coppicing in Romania

Experimental plots of restored coppices
Goals

- To study ability to resprout of desired tree species

- Managment models to produce highest possible amount of biomass

- Allometric equation to calculate biomass and energy in a coppiced stand for different stages and different tree species

- To study the effect of coppicing on biodiversity

Experimental plots of restored coppices

- Two 4ha plots where high forest has been transformed into coppices and coppices with standards

- Each plot divided into 16 of 50x50m subplots with 4 densities of residual trees

- All plots fenced

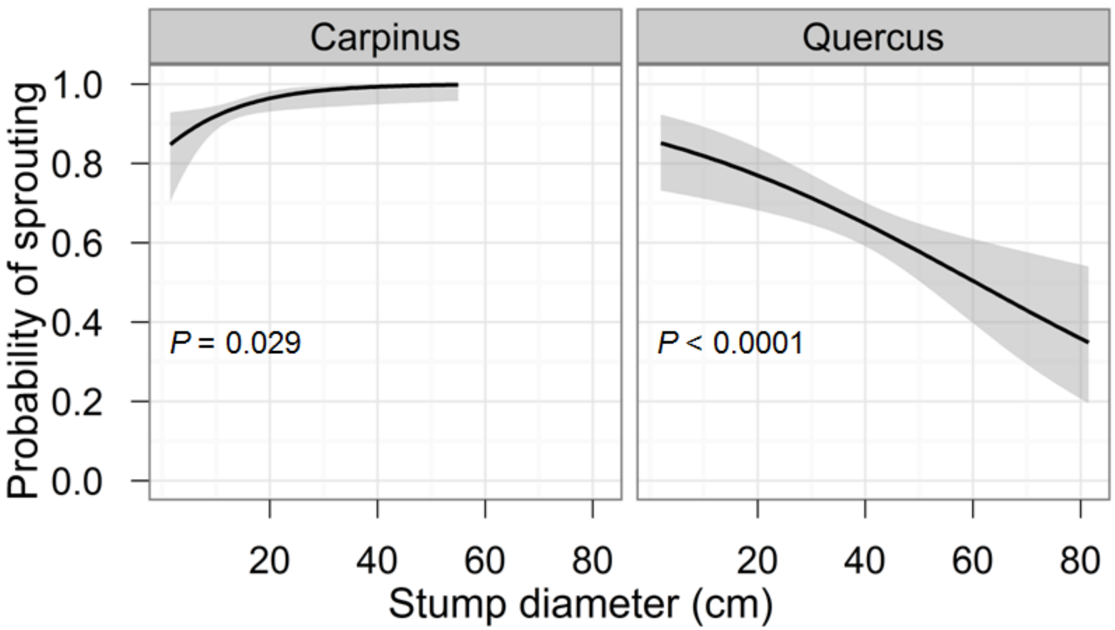
- All trees positioned and measured with Field-Map technology prior to cutting

- Phytocoenological releves set in the center of each subplot

Experimental plots of restored coppices

Experimental plots of restored coppices
Sprouting ability of target tree species

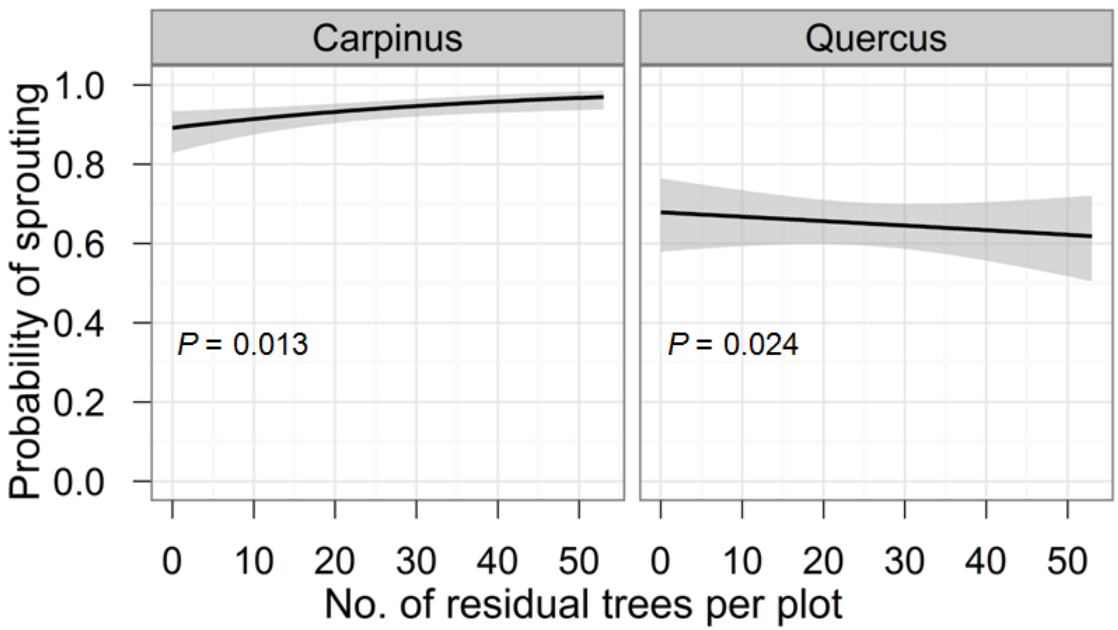
• 100% of lime (*Tilia cordata*) stumps resprouted, 94% in hornbeam (*Carpinus betulus*), 61% in sessile oak (*Quercus petraea*)



(Matula *et al., submitted*)

Experimental plots of restored coppices
Sprouting ability – effect of standards density

• Increase in hornbeam and decrease in oak with an increase in standards density



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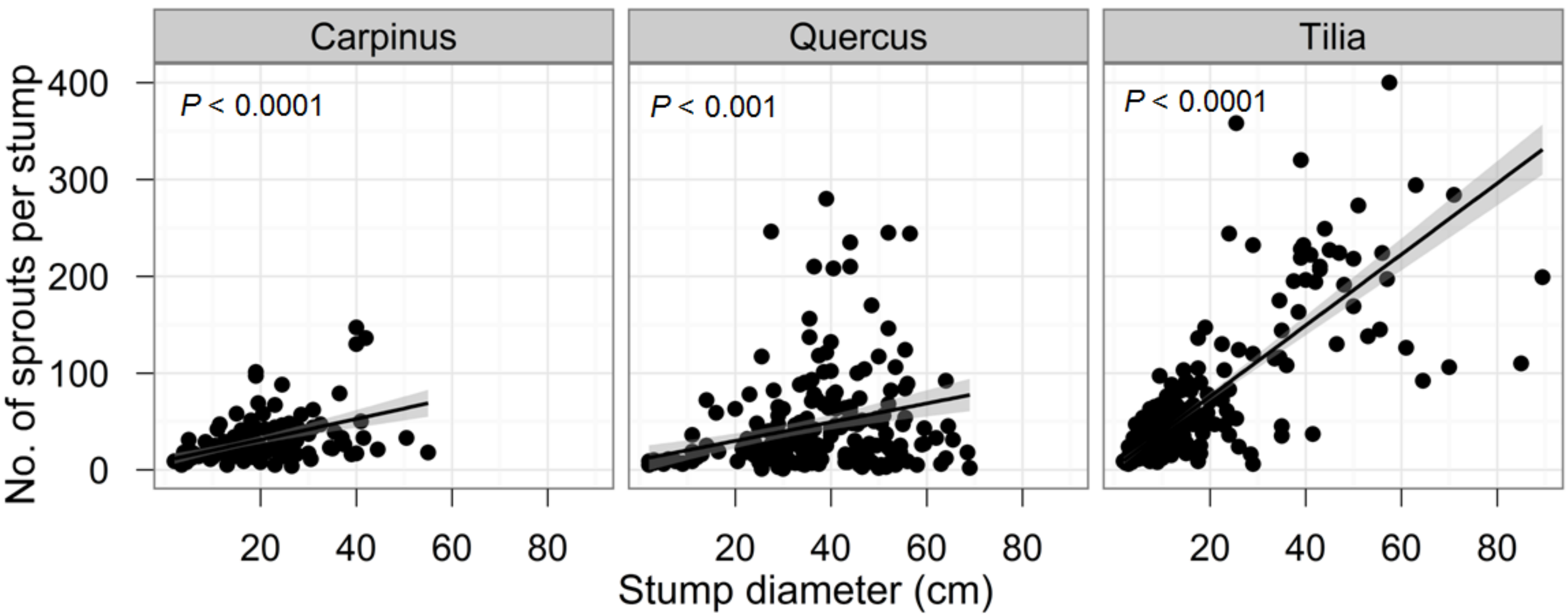
Experimental plots of restored coppices
Relationship between stump diameter and no. of sprouts

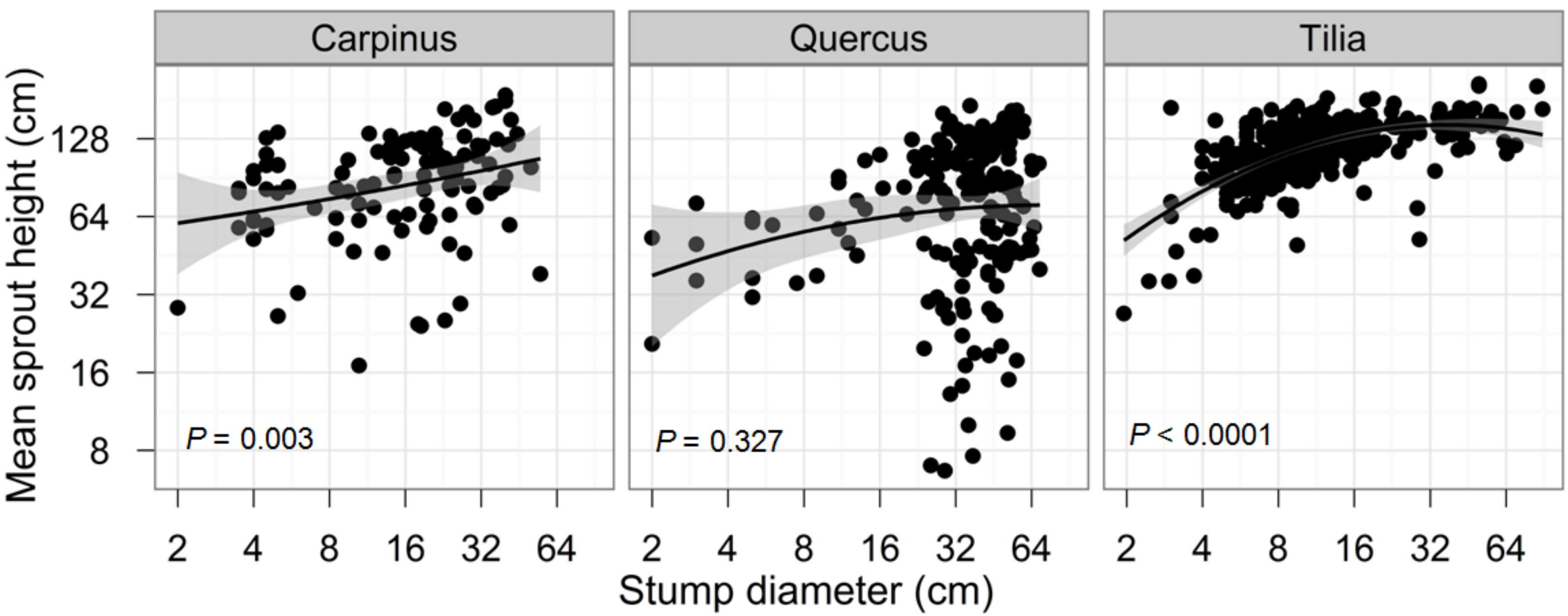
Number of sprouts increased with an increase in stump diameter



(Matula *et al., submitted*)

Experimental plots of restored coppices
Relationship between sprouts height and stump diameter

Significant increase of mean sprout height and diameter in lime and hornbeam

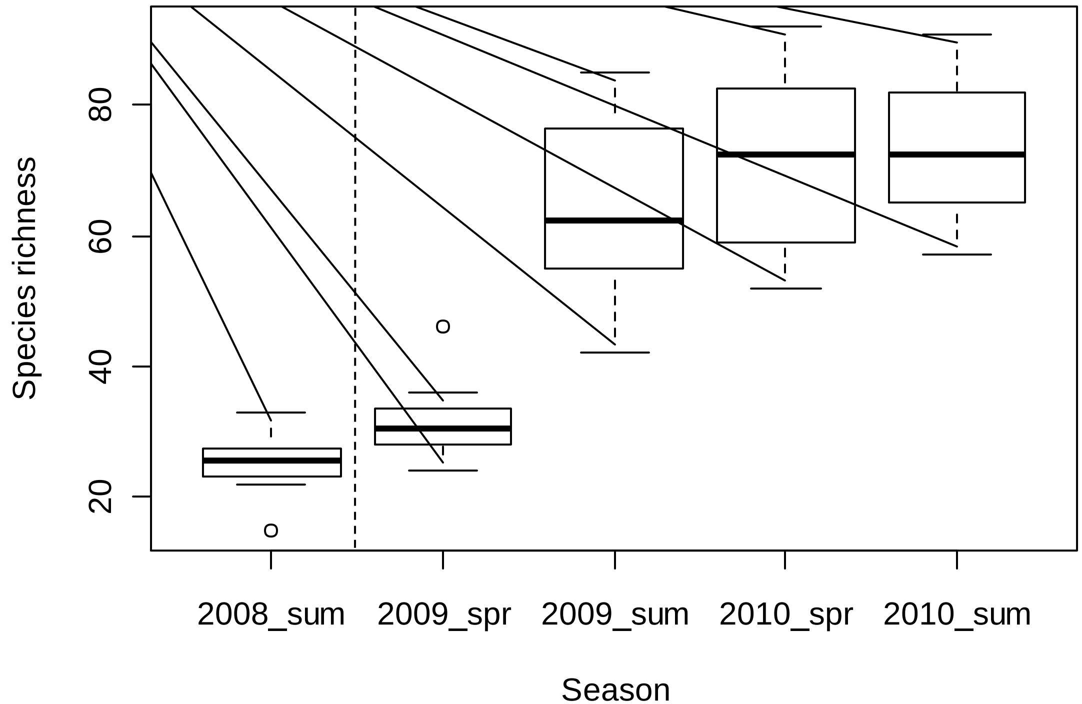


(Matula *et al.*, *submitted*)

Experimental plots of restored coppices

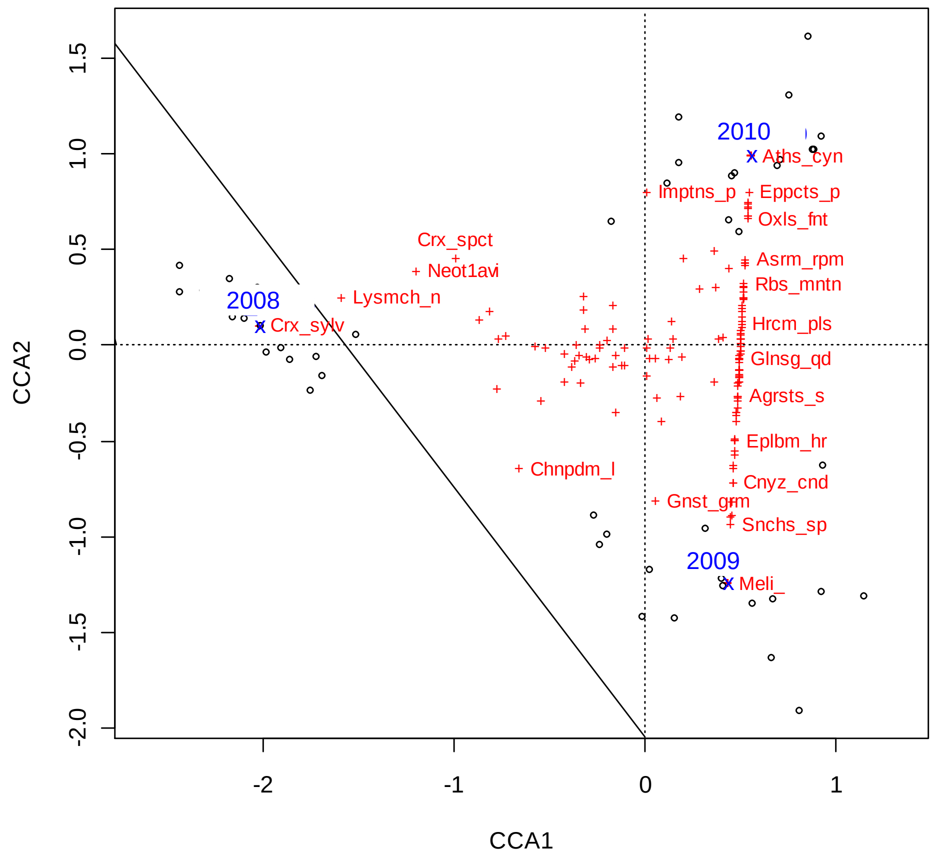
Changes in undergrowth diversity and composition

Diversity significantly increased after cutting.
(R^2 = 0,82, p < 0.0001)



Experimental plots of restored coppices
Changes in undergrowth diversity and composition

Significant changes in species composition in time.
($F = 3.7$, $p < 0.001$)



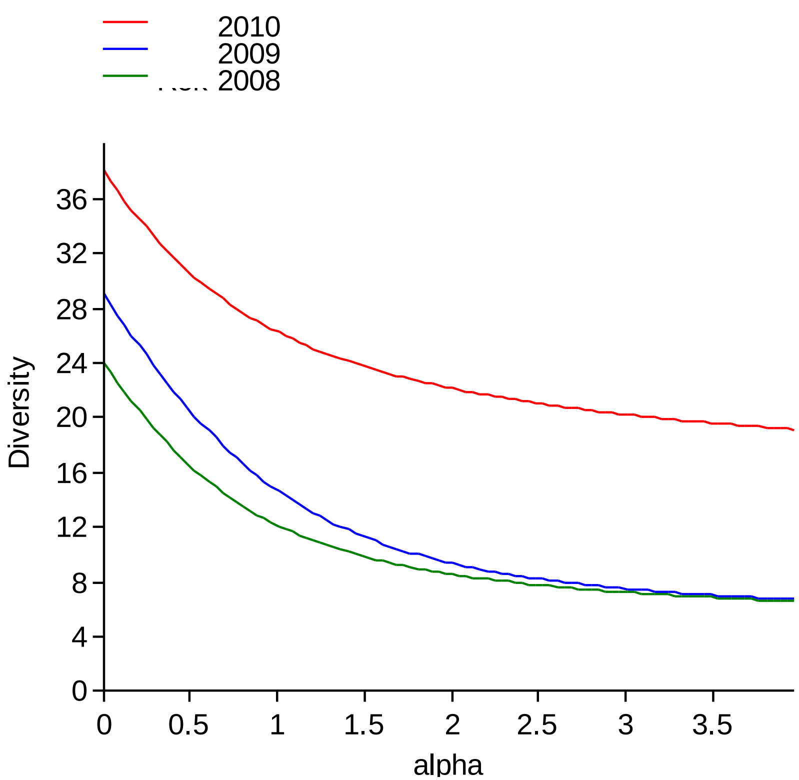
Experimental plots of restored coppices
Changes in undergrowth diversity and composition

Significant overall difference (Anosim: $R = 0.76$, $p < 0.0001$) as well as all pairwise comparisons ($p < 0.0001$) in species composition among seasons based on Bray-Curtis similarity index.

Species overlap (%)		**2010**		**2009**		**2008**
		summer	spring	summer	spring	summer
2010	summer	1	0.68	0.65	0.34	0.30
	spring		1	0.61	0.36	0.30
2009	summer			1	0.34	0.29
	spring				1	0.63
2008	summer					1

Experimental plots of restored coppices
Changes in undergrowth diversity and composition

Diversity profiles – clearly highest diversity second year after harvest



Results

- All studied species able to resprout until old age
- Lime had the best response to the transformation
- Lime may produce highest amount woody biomass
- Oak abundance will significantly decline
- Significant increase in diversity
- Significant increase in abundances of endangered species
- Significant increase in abundances of invasive species

Conclusions

- Transformation of old high forests into coppices possible

- Restored coppices may produce high amount of woody biomass without negative effects on the environment

- Coppice restoration may boost biodiversity

Implication

- Attractive especially for small forest owners
    - *Profit in short time compared to high forest*
    - *Low reforestation and management costs*
    - *Increasing demand for firewood from local communities*
- Desired management in many protected areas
    - *Habitats for endangered species*
    - *New source of income from protected forest*
    - *May use up increasing nitrogen content in soils*

Further step - application

- Results of this study will be used for a coppice restoration project

- On area of 200ha of high forests located in the neighbourhood of the city Brno

- Central heating systems for newly constructed houses and buildings using the biomass from the coppices

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Thank you for your attention