FORRISK Final Conference

Ansfelden | 26.09.2022

Manual for future crisis and risk management:

Overview on risks and general recommendations on forest protection

Thomas Kirisits, Peter Baier, Sigrid Netherer
and the FORRISK project team

Project co-funded by the European Union

FORRISK project region on the border between Austria and Czech Republic

Abiotic and biotic risk factors

- **Climate change**
- Wind damage
- Snow (ice, rime) and frost damage
- Forest degration
- **Drought**

- **Bark beetles**
- Fire
- **Game damage**
- Emerging pests and diseases
- Major risk factors of the main tree species

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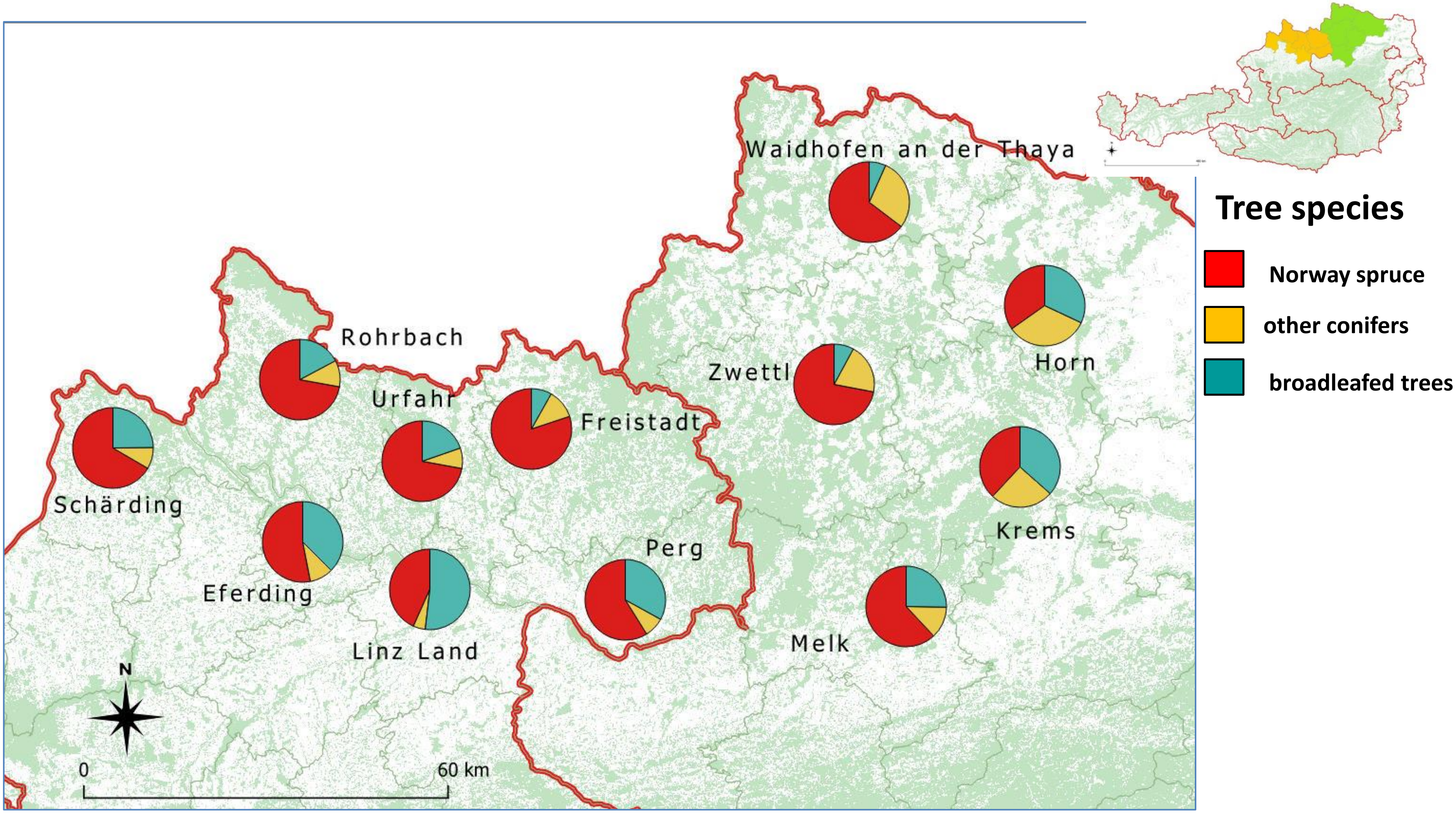

Data source: Austrian Forest Inventory 2007/09 (http://bfw.ac.at/rz/wi.home)

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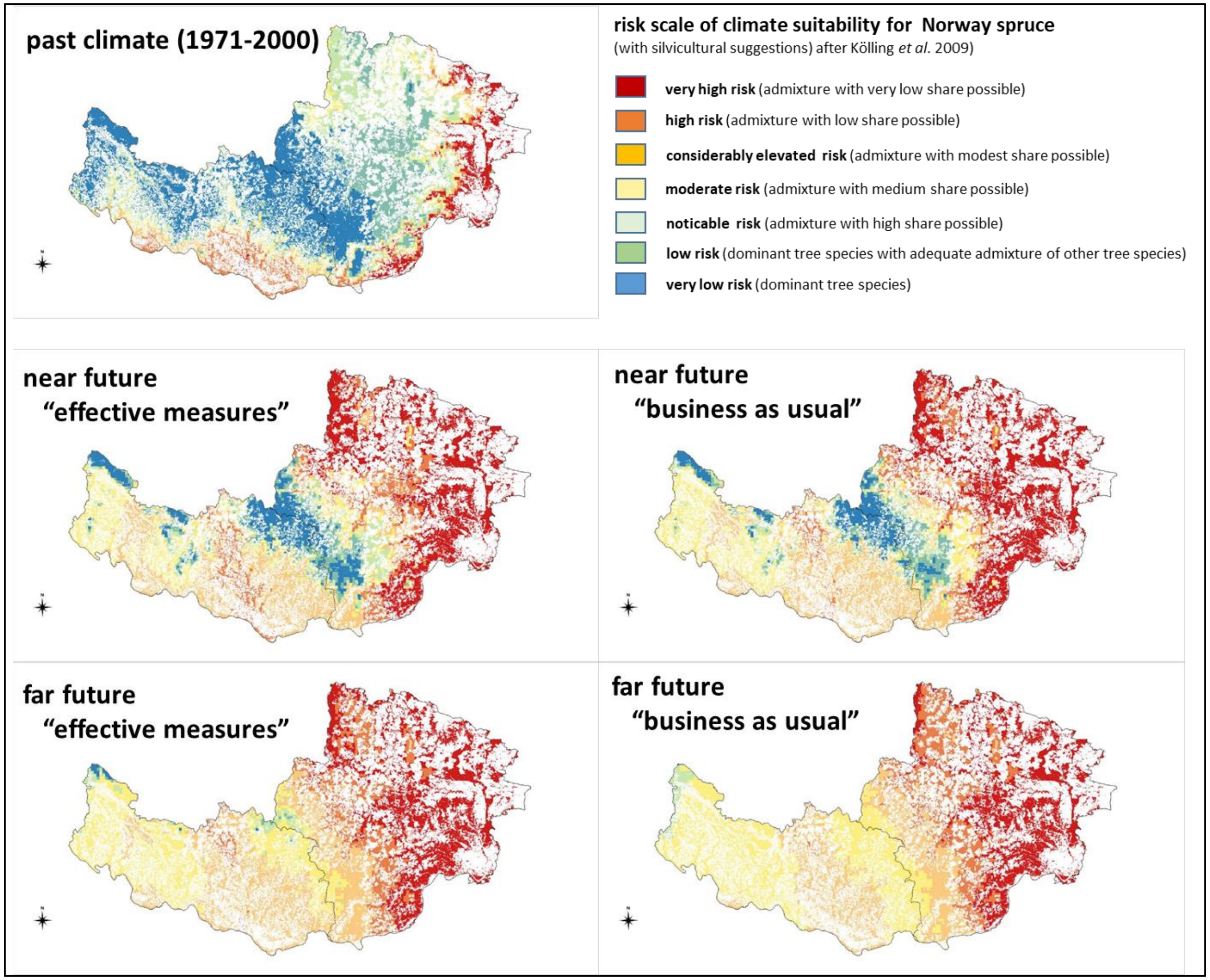

Climate suitability for Norway spruce (Kölling et al., 2009) in the regions Wald- and Mühlviertel in the past and in the near and far future for two different scenarios

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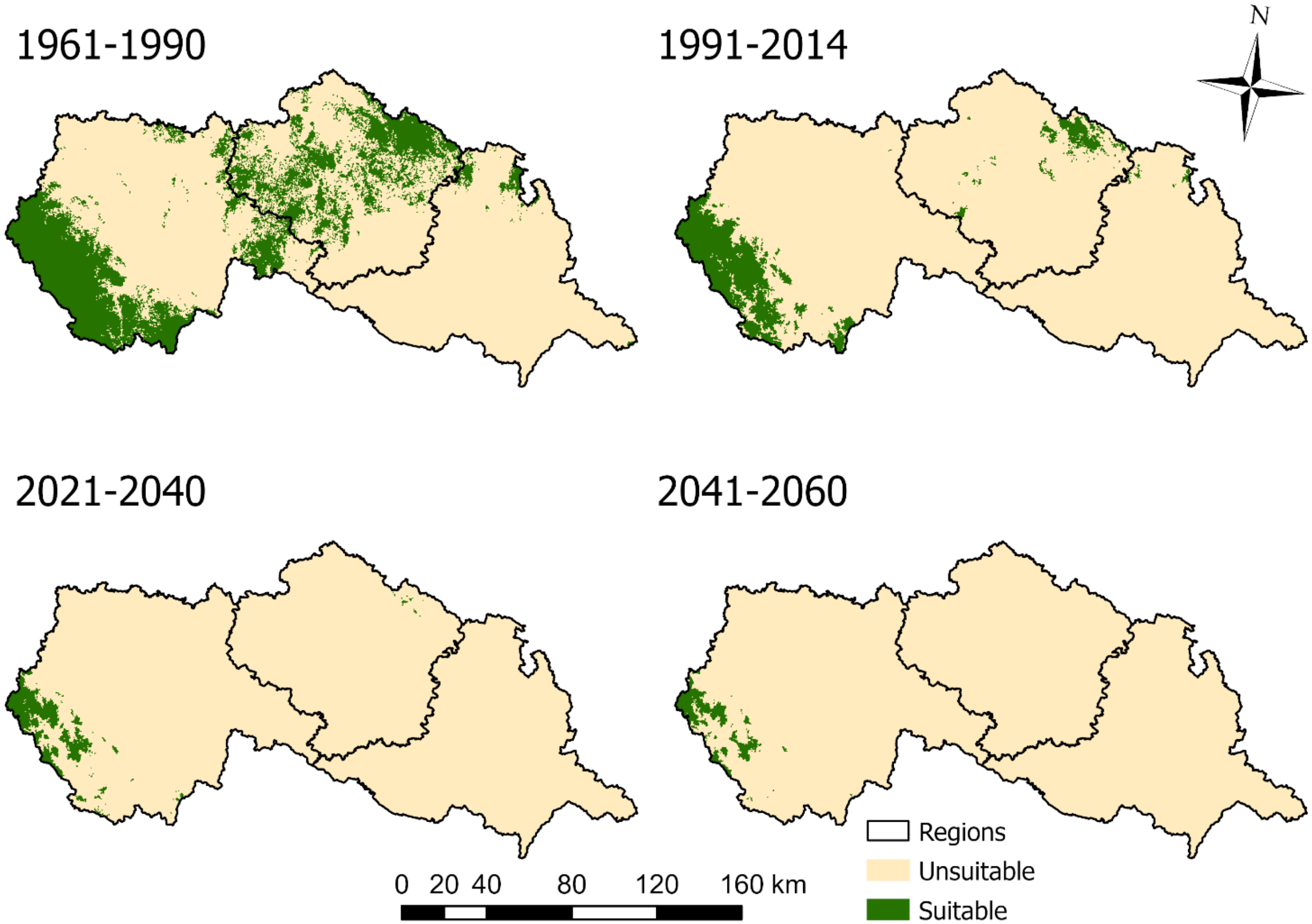

Climate suitability for Norway spruce in the regions of South Bohemia and Moravia in the past and in the near and far future for scenario rcp4.5

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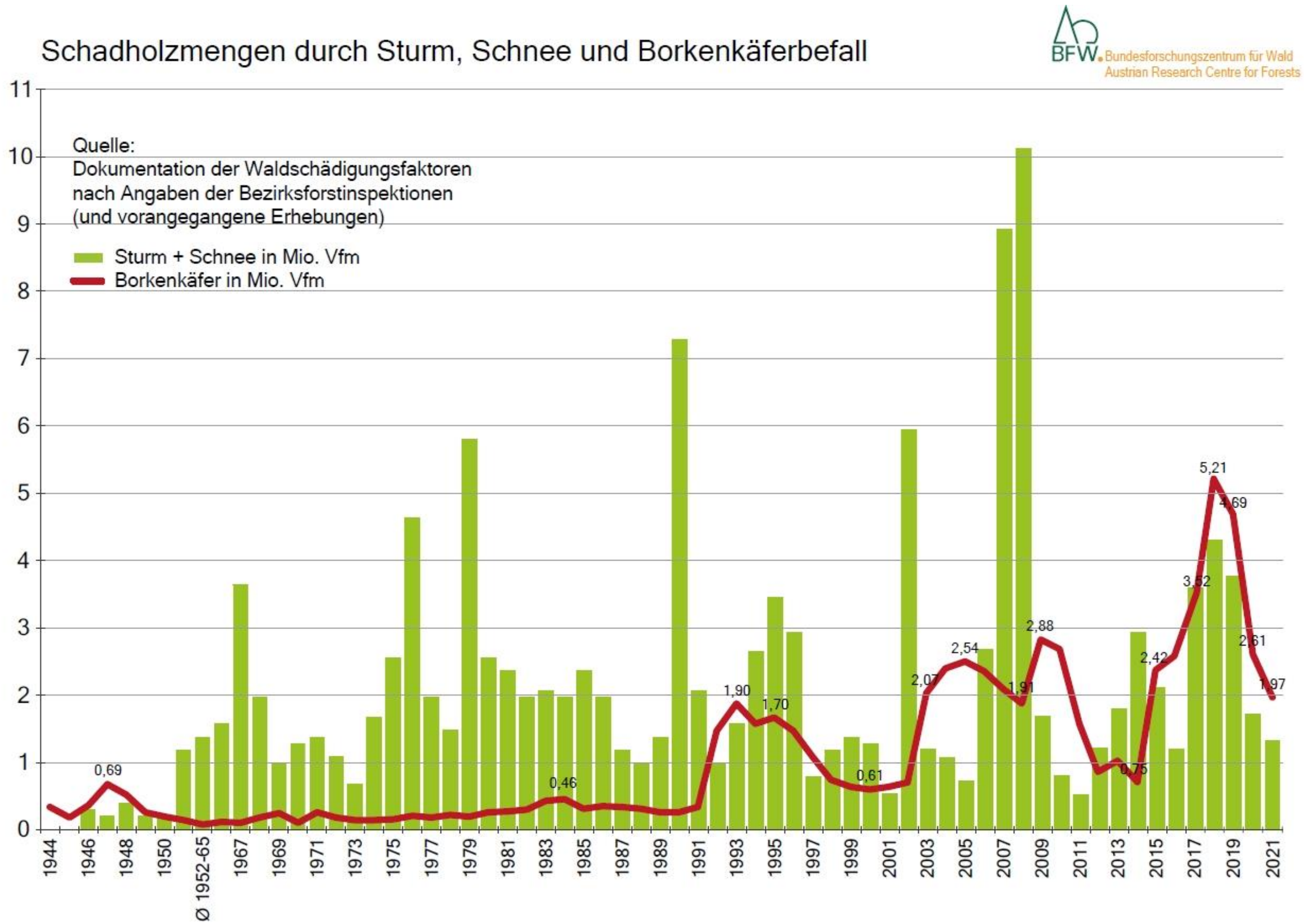
Annual damage by bark beetles (red line) and storm/snow (green bars) in Austria



Data source: Documentation of forest damaging factors (DWF, BFW)

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Tree species	Abiotic factors						Biotic factors: Insects		Biotic factors: Patho-gens		Biotic factors: Game
	Wind/Storm	Snow	Frost	Drought	Fire	Degradation	Bark beetles	Other insects	Root rot/ Honey fungus	Other pathogens	Game damage
Spruce	very high	very high	moderate	very high	high	very high	very high	moderate	very high	moderate	high
Silver fir	high	moderate	very high	moderate	moderate	low	low	high	low	low	very high
Scots pine	moderate	high	low	high	very high	very high	very high	high	high	high	moderate
Larch	moderate	low	moderate	high	moderate	moderate	high	high	high	high	very high
Douglas fir	high	moderate	high	moderate	high	low	moderate	moderate	moderate	high	very high
Beech	moderate	moderate	high	moderate	low	low	low	moderate	low	moderate	high
Oak	moderate	moderate	high	low	low	low	low	moderate	moderate	moderate	very high
Sycamore maple	low	moderate	moderate	high	low	low	low	low	moderate	high	very high
Ash	moderate	moderate	high	moderate	low	low	moderate	low	high	very high	very high

Rating of hazards

- low
- moderate
- high
- very high

Rating of tree species to various risk factors (expert assessment by the FORRISK team)

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General recommendations on forest protection

- Preventive forest protection
- Are mixed forests more resistant to disturbance?
- Non-native tree species – chance or risk?
- Management of major risk factors

Conservation biological control
→ promotion of natural enemies

Salvage and timber logistics
→ timely removal or treatment (e.g. de-barking, chopping, wet storage) of suitable breeding material

Silviculture, forest management
→ stable stands, tree species composition, accessibility

Documentation of infested areas

Early detection of infested trees
→ mainly ground surveys

Sanitation
→ removal and treatment (e.g. debarking, insecticides, Storanet®, wet storage) of infested material

Monitoring
→ pheromone traps, trap trees, PHENIPS plus, ...

Catching of beetles
→ trap trees (timing of measures!), pheromone traps, Trinet®, ...

Timber storage
→ wet and dry storage (to preserve timber quality, prevent infestation, respectively avoid emergence of beetles)

Integrated bark beetle (*Ips typographus*) recommended / practiced in Austria and Czech Republic

Are mixed forests more resistant to disturbance?

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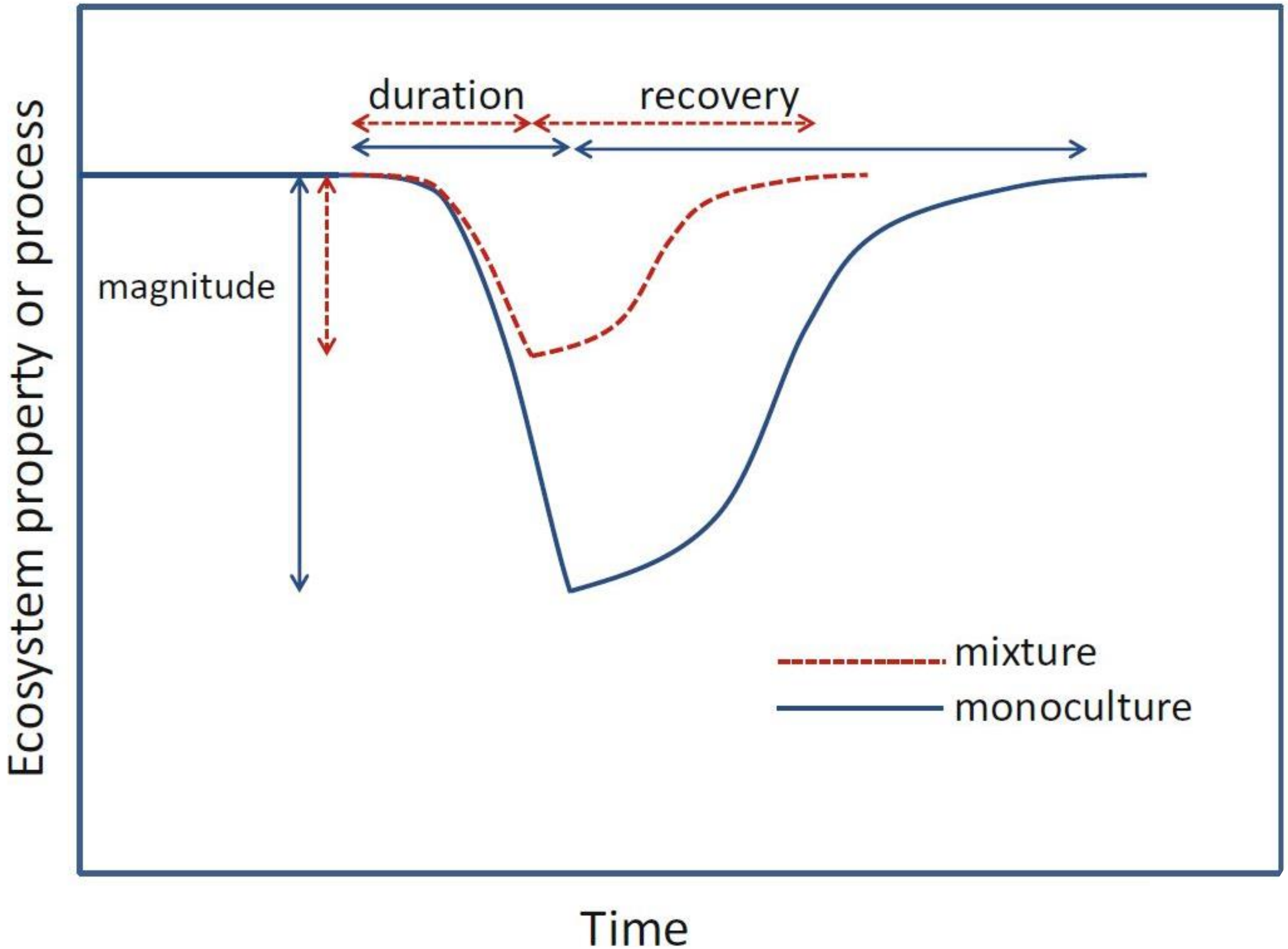

Conceptual illustration of hyptheses related to the response of mixed-species forests to disturbance or environmental stress

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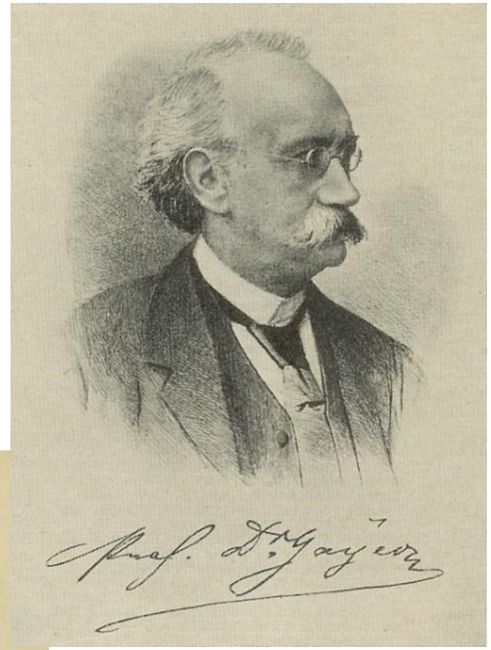
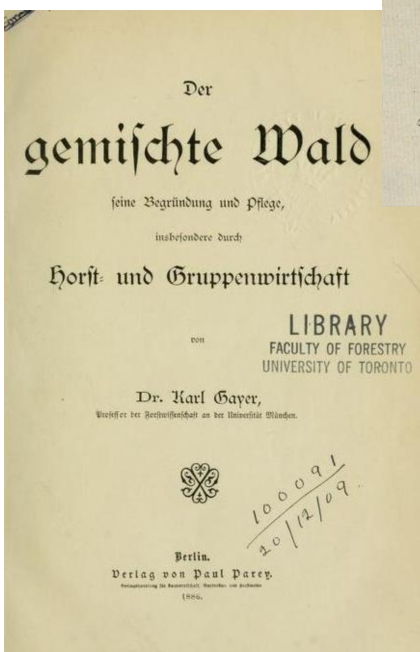
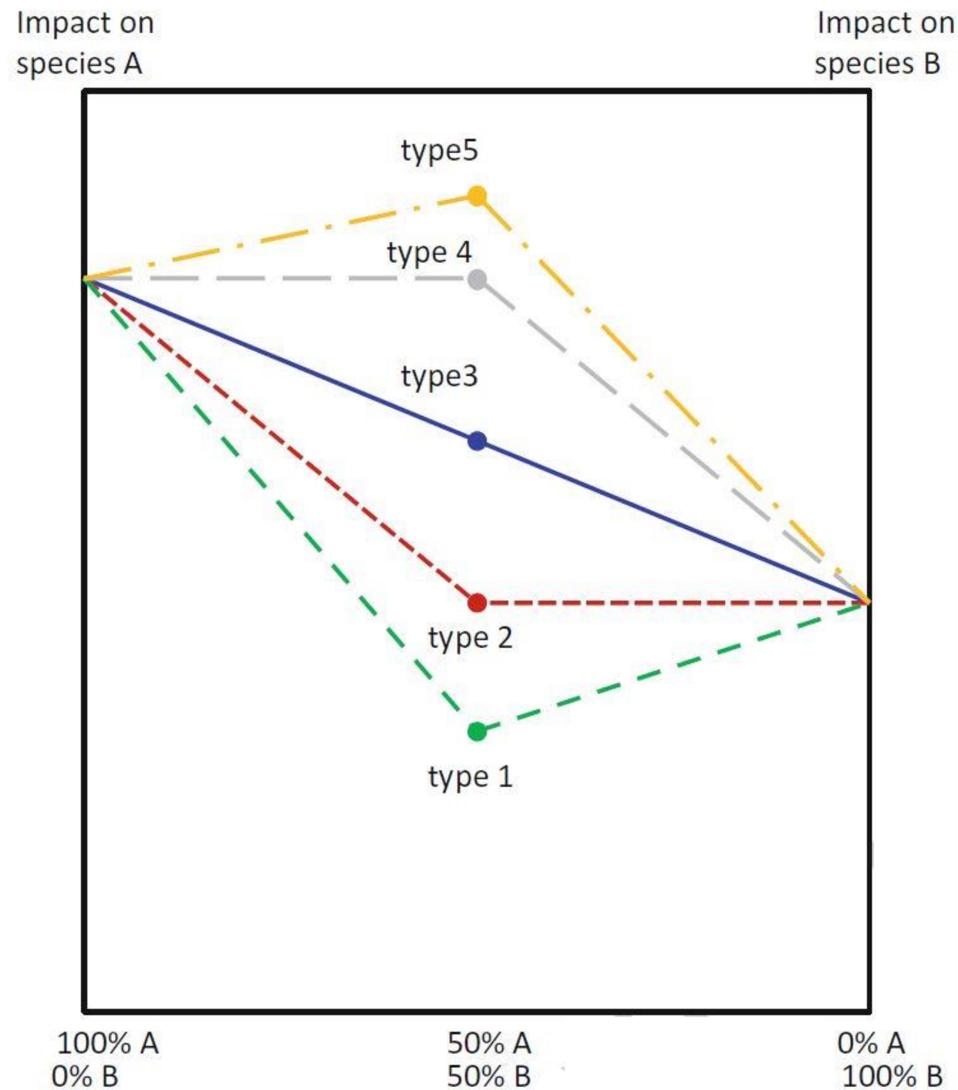
Karl Gayer
(1822–1907)





Der
gemischte Wald
seine Begründung und Pflege,
insbesondere durch
Horst- und Gruppenwirtschaft
von
Dr. Karl Gayer,
Professor der Forstwissenschaft an der Universität München.
Berlin.
Verlag von Paul Parey.
1886.

Der gemischte Wald (1886)



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Effects of tree species mixture on the resistance to different factors

→ **Generalisations difficult**

→ Effects depend on **disturbance factor**

→ Strong **synergistic effects** in the case of **specialis**t insect herbivores and pathogens

→ **Involved tree species** and their characteristics **more important** than tree species diversity *per se*

(green)	High evidence
(orange)	Medium evidence
(yellow)	Low evidence
⇧	Synergistic effects
⇨	Intermediate in mixtures
⬂	Varying (also negative) effects

Stress / Disturbance	Resistance of mixed stands
Drought	⬂
Wind / Storm	⇨
Fire	⬂
Specialist insect herbivores	⇧
Generalist insect herbivores	⬂ ⇧
Specialist pathogens	⇨
Generalist pathogens	

→ Mixing of **phylogenetically distant tree species** and with **different functional characteristics**

→ Mixing of **broadleaved** and **conifer species**

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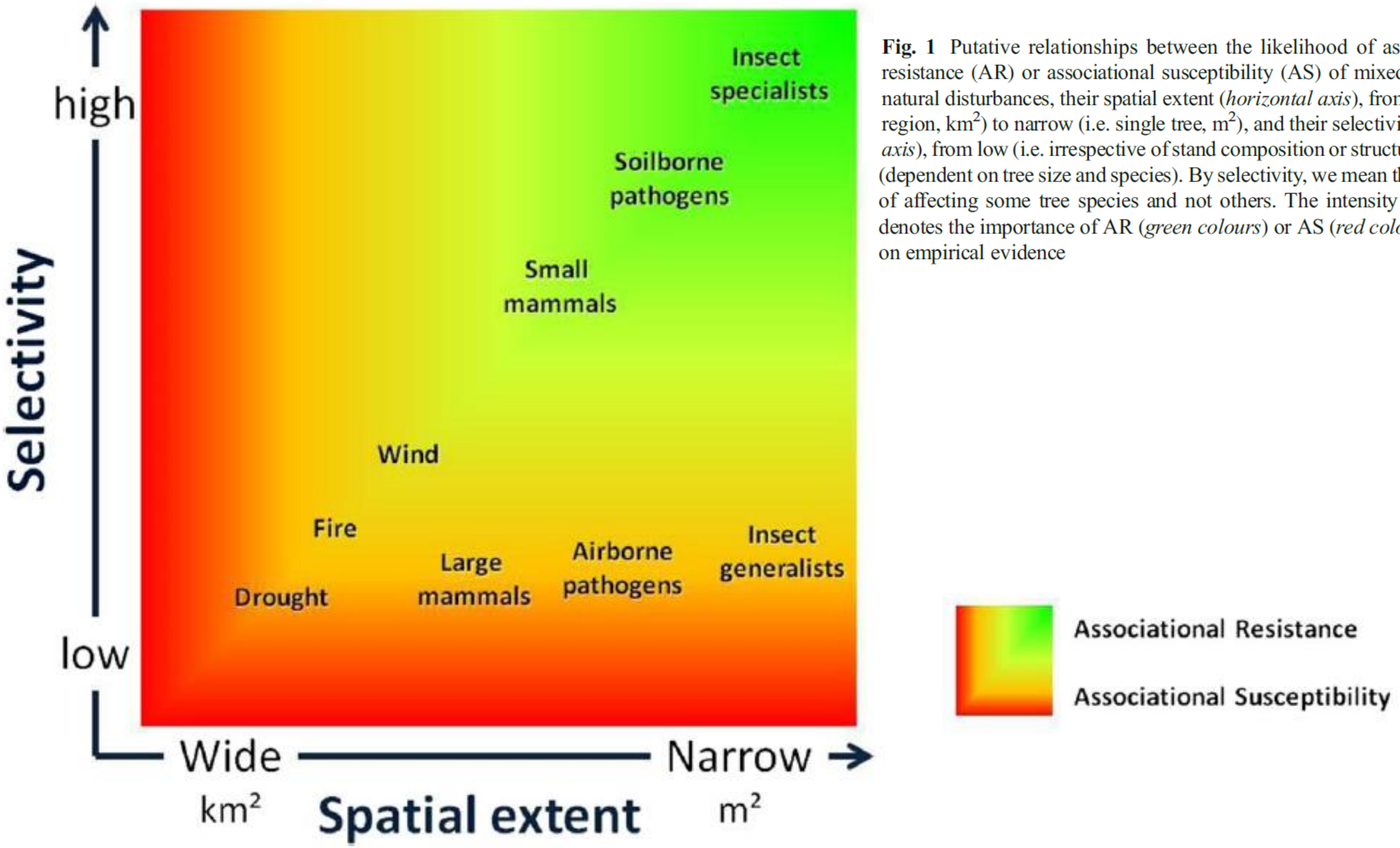

Fig. 1 Putative relationships between the likelihood of associational resistance (AR) or associational susceptibility (AS) of mixed forests to natural disturbances, their spatial extent (*horizontal axis*), from wide (i.e. region, km^2) to narrow (i.e. single tree, m^2), and their selectivity (*vertical axis*), from low (i.e. irrespective of stand composition or structure) to high (dependent on tree size and species). By selectivity, we mean the property of affecting some tree species and not others. The intensity of colours denotes the importance of AR (*green colours*) or AS (*red colours*) based on empirical evidence

Diversification of risk / Insurance hypothesis

Complementary in resistance traits and facilitation

Reduction of fuel / food resources

e.g. resource concentration hypothesis

Multi-trophic interactions enhancing symbiosis and predation

e.g. enemies hypothesis

Competition for resources

Reduced host/target tree accessibility through disruption or diversion

e.g. semiochemical diversity hypothesis, attractant-decoy

Spillover, contagion and alternating between host trees

General mechanisms of **associational resistance** and **associational susceptibility** to natural disturbances in forests

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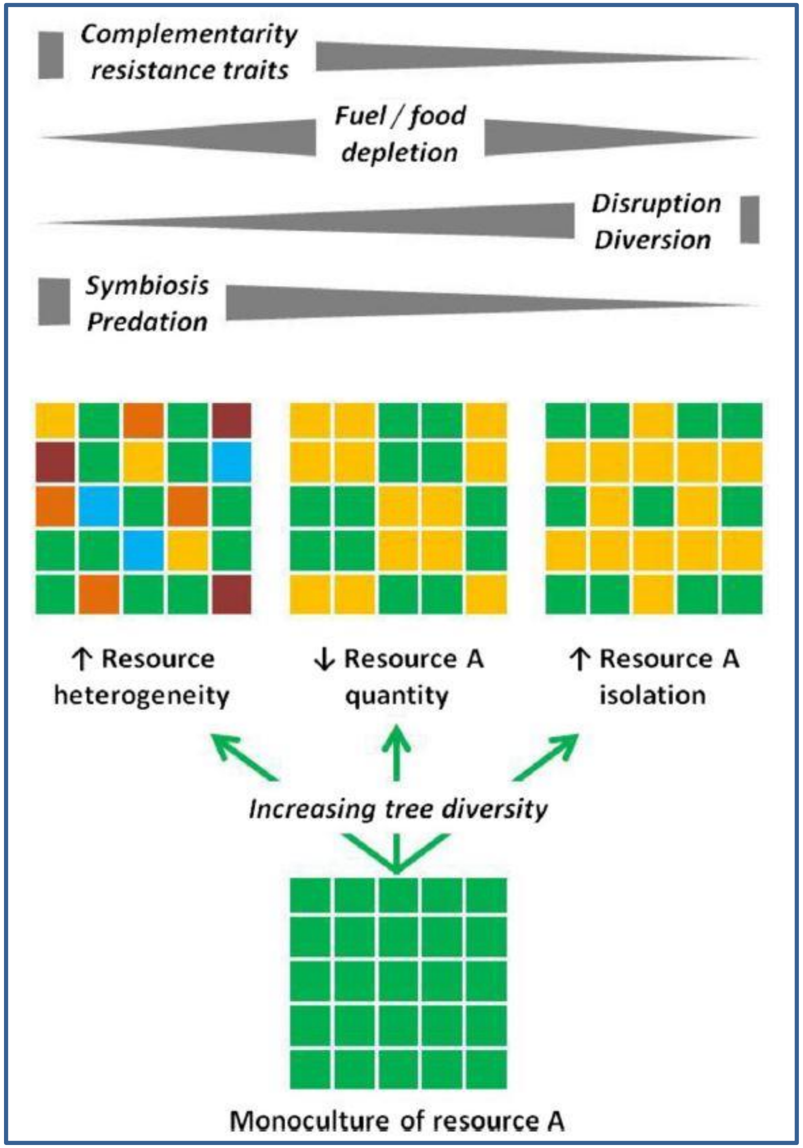
Correspondence between three aspects of stand diversity...

- Increase of **resource heterogenity** through an assembly of of tree species with different traits
- Reduce **resource quantity**
- Limit **resource connectivity**

...and four putative mechanisms of associational resistance

- Complementarity in resistance traits
- Fuel / food depletion
- Biotic interactions (symbiosis, predation)
- Host finding disruption or diversion



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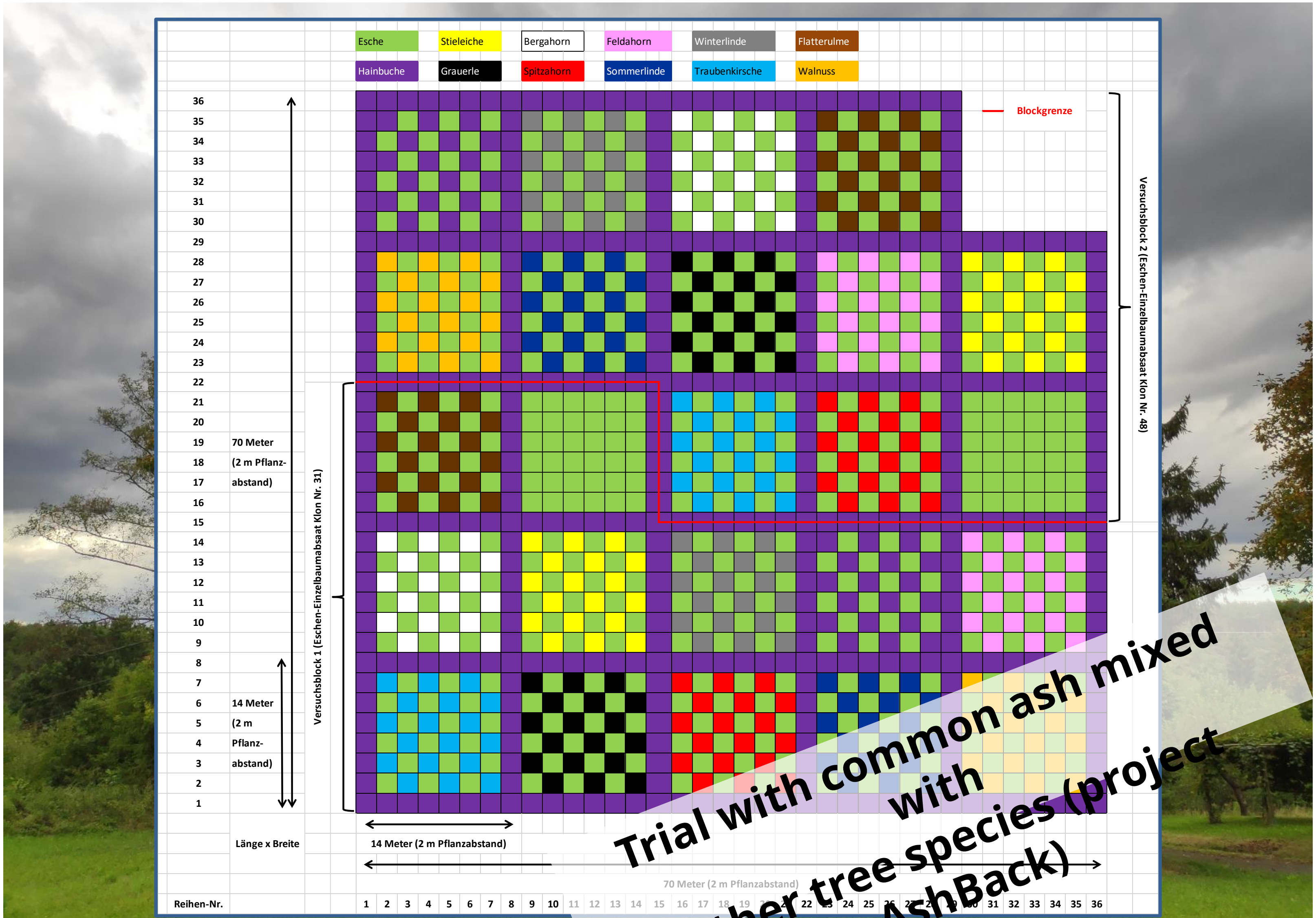

Trial with common ash mixed with other tree species (project AshBack)

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