

# New Generation of Mixed-Species Experiments for Science and Practice

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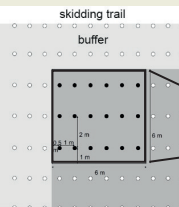
## STANDARDS FOR TWO-SPECIES MIXING EXPERIMENTS

### Multi-factorial (F) experiment design

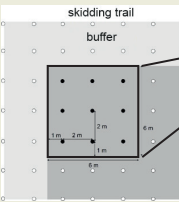
F: species combination

	<b>Douglas fir</b> <i>Pseudotsuga menziesii</i>	<b>Norway spruce</b> <i>Picea abies</i>	<b>Scots pine</b> <i>Pinus sylvestris</i>	<b>Sessile Oak</b> <i>Quercus robur</i>	<b>Silver fir</b> <i>Abies alba</i>
<b>European beech</b> <i>Fagus sylvatica</i>					
<b>Sessile Oak</b> <i>Quercus robur</i>					

spacing 1 m x 2 m  
(5.000 ha<sup>-1</sup>)



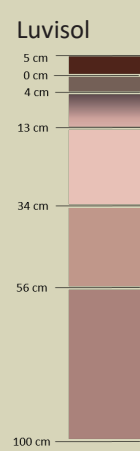
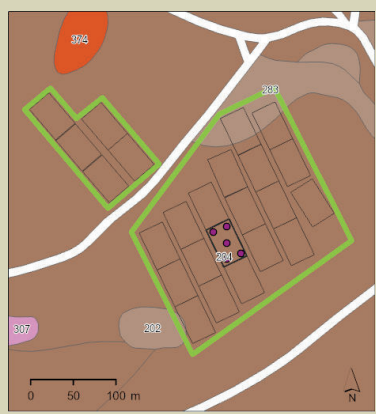
spacing 2 m x 2 m  
(2.500 ha<sup>-1</sup>)



high  
F: stand density  
low

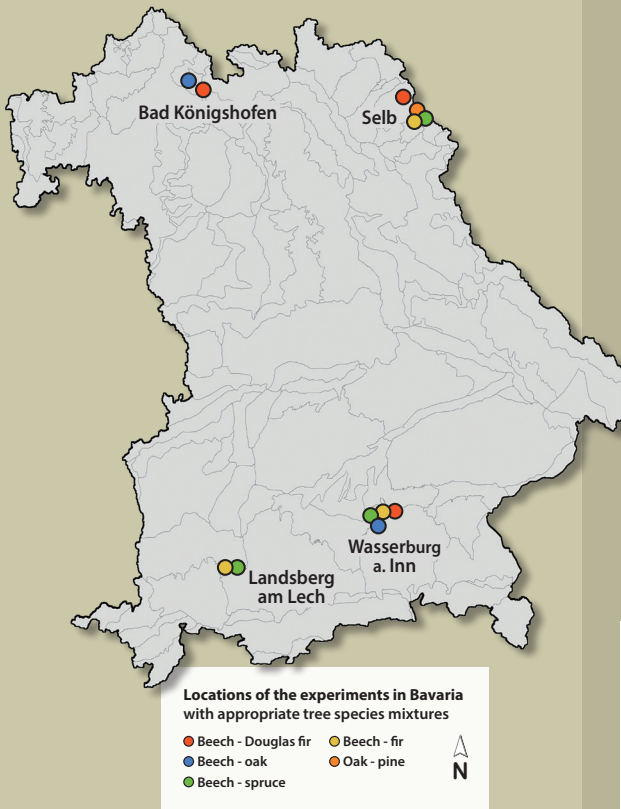
High initial density,  
no management  
High initial density,  
moderate density  
regulation  
Low initial density,  
strong density  
regulation

Detailed assessment  
of soil conditions

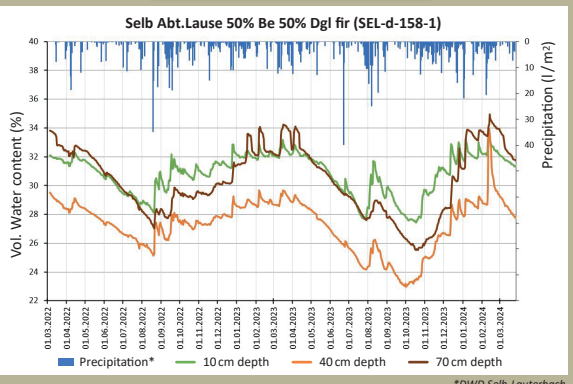


F: growing condition

Repetition of species mixtures on different sites:  
■ dry to moist  
■ oligo trophic to eutrophic

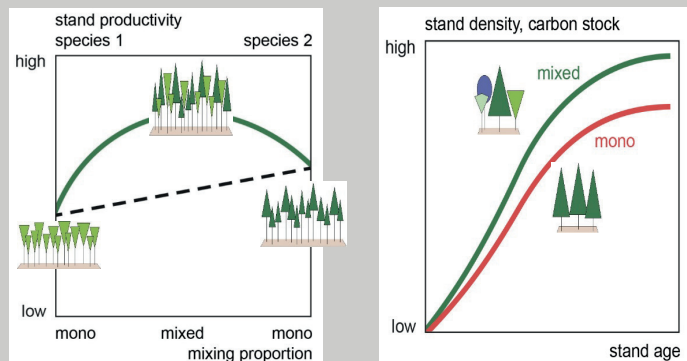


Detailed monitoring of climatic variables:  
■ soil water balance  
■ temperature



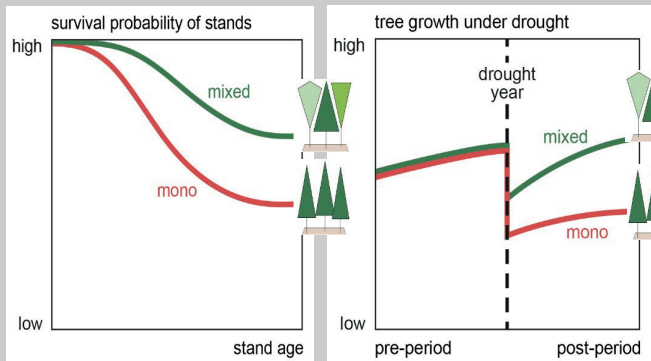
### Basis for research on mixing effects and climate adaptation

#### Productivity and growth



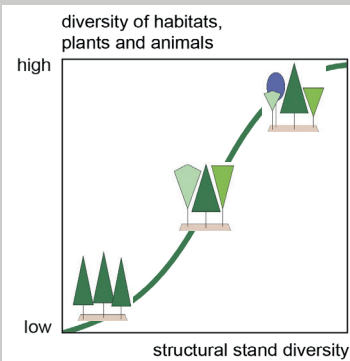
e.g. del Rio, M. et al. 2016: Characterization of the structure, dynamics, and productivity of mixed-species stands: review and perspectives. *European Journal of Forest Research* 135(1):23-49

#### Resilience and stability

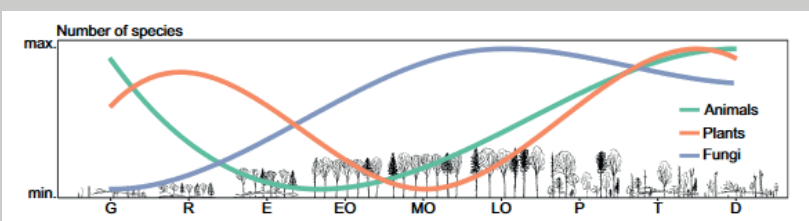


e.g. Pardos et al. 2021: The greater resilience of mixed forests to drought mainly depends on their composition: Analysis along a climate gradient across Europe. *Forest Ecology and Management* Vol. 481 (p. 15)1

#### Biodiversity and ecosystem service provision

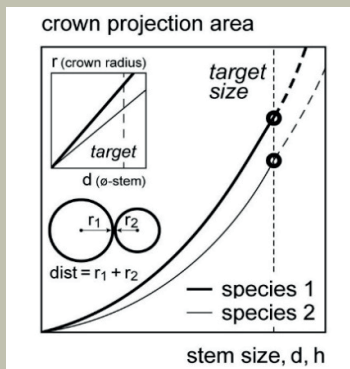


e.g. Hilmers, T. et al. 2018: Biodiversity along temperate forest succession. *J Appl Ecol.* 55(6):2756-2766



### Development of maintenance and thinning regimes for integrated management of mixed stands

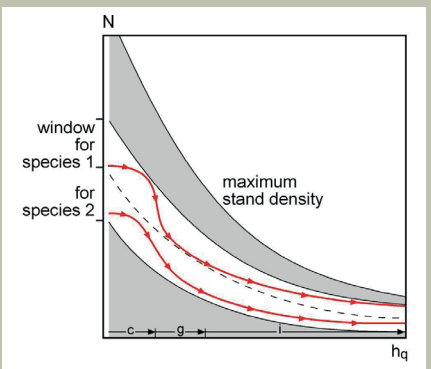
#### Species-specific spacing requirements



#### Density transformation

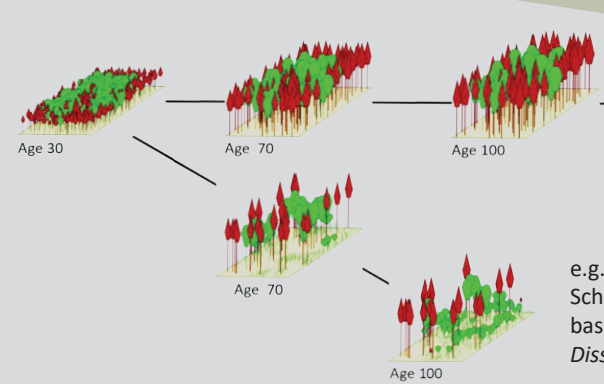
	species 1					
d(cm)	10	20	30	40	50	
10	1.3	0.4	0.2	0.1	0.1	
20	4.7	1.5	0.8	0.5	0.3	
30	7.2	2.3	1.2	0.7	0.5	
40	10.1	3.2	1.7	1.0	0.7	
50	26.5	8.4	4.3	2.7	1.9	

#### Species-specific density regulation



e.g. Pretzsch, H. et al. 2021: Silvicultural prescriptions for mixed-species forest stands. A European review and perspective. *European Journal of Forest Research*

### Education, training and scenario analysis



e.g. Schwaiger et al., 2019: Schematic representation of the inventory based scenario simulation with SILVA. *Dissertation*



Scientific symposium  
Promoting diversity in  
plant-based ecosystems  
as a tool for  
Ecosystem Services provision



Universidad de Valladolid

