



FunDivEUROPE

Functional significance of forest biodiversity in Europe

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Timber quality and crown/growth parameters

FunDivEUROPE (FP7) field protocol

V1.0

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1 Introduction

In addition to certain ergonomic and economic advantages in establishment, tending and harvesting mono-specific stands, quality development of such stands may be more homogenous than in mixed forest stands. However, apart from some well documented interspecific effects on tree quality, such as qualification of lower stem sections of valuable hardwoods by subdominant and suppressed shade-tolerant species (trainer species), comprehensive knowledge about these interspecific influences is scarce and urgently needed for many species combinations across Europe. Especially considering increasing demands for management schemes incorporating biodiversity enhancement and conservation, which could result in an increasing degree of diversity both in age and canopy structure as in species composition, the question of whether timber quality may benefit or suffer from such structures and compositions is of vital interest.

2 Scope and application

The sampling design comprises basic measurements on all plots and more detailed measurements on a subsample. In this way, the overarching project philosophy of including proxy measurements for all study sites is reconciled with the interest to produce a more detailed assessment of the influence of diversity on timber quality.

On all plots, a proxy assessment of timber quality will be conducted for two species of commercial interest per region. On plots, where the selected species are not present, one to two alternative species will be selected and assessed. The sampling will be done on the same number of trees for each plot, except in cases where trees are too small to be included.

For the regions Germany, Finland, Romania and Poland as the regions harbouring plots in forests with a management goal of quality timber production or which are comparable to such forests with respect to species composition and site characteristics, a detailed quality measurement including crown parameters will be conducted for the two selected target species per region. Here the sampling will be neighbourhood-based, as opposed to plot-based and the goal is to find at least one suitable neighbourhood per plot where the selected species are present.

Basic dendrometric data (height, 2 DBH, crown base) and crown and timber quality parameters (crown projection area/width, vertical crown dimension, branchiness, health, eccentricity, taper, straightness) will be collected on all suitable plots of the exploratory platform (n=214). Field work will be done by the PhD student, site technicians, student helpers and bachelor/master students.

3 Objectives

The objective is to explore (1) whether the variability in quality of tree stems increases with plot and neighbourhood tree species diversity and (2) whether stem quality of individual trees is dependent the species identity of neighbouring trees. Individual tree timber quality parameters and neighbour tree crown and stem size/position data will enable us to model the effect of neighbour species on the target subject trees with respect to timber quality.

4 Location of measurements and sampling

4.1 Field sampling design

Number of replicates

6 trees for each plot (6 of single species, 3+3 per two or more species plot) per region = 214×6 = 1284 trees for proxy quality assessment

$2 \times 5 \times 5$ (2 species \times 5 neighbourhoods \times 5 replications) per region (6) = 50 combinations \times 6 = approximately 300 target – neighbour plots

4.2 Sampling scheme

In each focal region, two important commercial forest species have been selected as target species (Finland: *Betula spec.* + *Picea abies*; Poland: *Quercus robur* + *Picea abies*; Germany: *Fagus sylvatica* + *Acer pseudoplatanus*; Romania: *Fagus sylvatica* + *Acer pseudoplatanus*; Italy: *Quercus petraea* + *Castanea sativa* (possibly *Quercus ilex*); Spain: *Pinus sylvestris* + *Quercus ilex*). For the target-neighbour design (Frech et al. 2003, Kaitaniemie and Lintunen 2010, Potvin and Dutilleul 2009, Thorpe et al. 2010), neighbourhood combinations ranging from mono-specific to most diverse (3-4 different species neighbours) will be selected (five replications per species combination per species for statistical reliability). The lower diameter limit for meaningful timber quality assessment is set to 15 cm. Tree height and diameter, crown parameters and branches/branch scars will be tallied/measured on all trees.

4.3 Sampling equipment

Tape measures, diameter tape measure, measuring rod, calliper rulers, laser distance sensor for crown projection area and distances), crown mirror (densiometer for crown edge measuring); Vertex ultrasonic measuring device (for heights, crown base height), ladder, clinometers, compass, callipers, range poles

4.4 Frequency of sampling

Once, no re-measurement.

5 Measurements

5.1 Simple quality assessment for main species

Based on the timber quality assessment schemes of the German Forest Inventory (BWI 2 2004) and a scheme developed for the EU-funded research project MEFYQUE (Final Project Report), a proxy classification of timber quality will be done for the two target species, and, on plots where target species are not present, one or two substitution species. 6 trees per plot will be selected for this assessment (6 mono-specific or 3+3 for target species). The selection will be randomized for all trees above 15 cm dbh.

Table 1: parameters, unit and goal of measurements for simple quality assessment

Parameter	Explanation	Unit	Tool	Goal
DBH	NA	cm	Tape measure (data available already)	Dimension as a quality characteristic
Height	NA	m	Clinometer/Vertex	Dimension as a quality characteristic
Upper crown height (conifers)	first whorl with more than half live branches	m	Vertex/Laser dendrometer	Crown descriptor
Upper crown height (broadleaved)	lowest complete crown in all directions	m	Vertex/Laser dendrometer	Crown descriptor
Lower crown height	Lowest live branch	m	Vertex/Laser dendrometer	Crown descriptor
Dominance class	Acc. To Kraft (source)	1-5	Visual assessment	Vitality descriptor/competition status

Parameter	Explanation	Unit	Tool	Goal
Quality classes (conifers)	acc. To BWI2 and Mefyque	3 classes ¹	Visual assessment	Actual quality assessment
Quality classes (broadleaved)	acc. To BWI2 and Mefyque	3 classes ²	Visual assessment	Actual quality assessment
Stem lean	maximum lean angle and azimuth for first 4 m	degrees	large set square	estimation of compression/tension wood presence;

5.2 Detailed quality assessment of target trees

On a subsample of available trees (at least one target-neighbour combination per plot, 5 replications per species and per diversity level per region), more detailed crown and quality measurements will be conducted. The target tree will be selected according to the following criteria: belonging to target species, diameter over 15 cm. The neighbor trees will be selected according to their competitive influence on the target tree with respect to light as modified by crown size, form and height of the neighbour tree. On this subsample the following parameters will be recorded:

Target trees:

DBH in cm will be measured in two perpendicular directions (longest and shortest) using a standardized 1.3 meter rod for height consistency where not marked yet and, on sloped ground, from the upper side. The two DBHs will allow for **eccentricity/ovality** estimations and complement the estimation of the impact of competition on stem form. The horizontal

¹A: one to two 5 m logs pruned or branch free; no curving; very few epicormics, very few to no pathologic defects; no waviness; no fissures/cracks

B: one 5 m log almost branch free, no branches above 4 cm above 5 m, few small epicormics; minor 1-sided curve acceptable, little taper; no mistletoe, minor pathologic defects; minor ovality; few branches;

C: large branches on total stem; curving, stem wounds, bumps, epicormics accepted

² A: minimum of 5 m log almost branch free, very small epicormics or branches ; no curving; no pathologic defects; no waviness; no fissures/cracks

B: one or more 2 m logs largely branch free, no branches over 10 cm above 2 m, few small epicormics; 1-sided curve acceptable; minor pathologic defects; minor ovality; few branches;

C: large branches on total stem; curving, stem wounds, bumps, epicormics accepted

angle (orientation) of the longest diameter will also be determined for standardization purposes and directional analysis.

Tree height in m will be measured using a Vertex (ultrasonic signal processing).

Bole taper in cm/linear meter will be determined by measuring two diameters per 2 m section (bottom and top of 2 m section) using tape measures and a range pole/geometer staff. This timber quality parameter is influenced by growth dynamics determined largely by competition.

Stem curving in cm/linear meter will be measured for stem sections of 3 m using a 3-m geometer staff or range poles as the reference line and a ruler for versine height, compass for versine azimuth. The geometer or range poles will be positioned starting above root collar. This will help assess the impact of competition on stem form.

Branch scars (up to 5 m - the target branch-free stem section height) will be counted and **branch scar diameter in cm** at branch base will be measured using a calliper ruler and a compass for branch wounds above 2 cm diameter. Likewise, if branch-free stem height is below 5 m, **branches** will be tallied and measured/categorized in this way.

Crown width (in m) and crown projection area (in m²) of target trees will be determined by measuring crown expansion towards each neighbour and, if necessary, in additional directions for less than 8 neighbours (determined using a compass). Using a densiometer, the perpendicular foot of the crown edge on the ground is determined for each direction and using a laser distance sensor, the distance to the stem is measured (DBH/2 is added to the distance). Crown projection area and crown width are measures for crown and tree vitality and form and are determined largely by competitive impact of neighbouring trees on the specimen.

Crown base height in m, height of lowest dead branch, lowest live branch, lowest contiguous live whorl will be measured using a ruler, the Vertex or the laser distance sensor. These parameters will allow an estimation of the crown development as influenced by competing neighbour trees as well as an estimation of timber quality.

From each target tree, **2 branches from the bottom crown** at a 90° angle (lowest live branches) will be photographed from below with a digital camera, recording the distance from ground to the respective branch base. In addition the diameter at branch base will be determined using a modified v-shaped calliper on an extension rod. This will allow for an estimate of past and present effect of the neighbour trees on crown expansion and branch growth rate.

Neighbor trees:

On each neighbour tree, crown expansion towards the target tree will be measured (see above). Height, two diameters (towards the target tree and perpendicular to that one), height to crown base and height to lowest dead branch, as well as stem lean and direction/angle of lean will be measured. In addition, a timber grading according to 5.1 will be conducted on these individuals.

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7 Preliminary sampling sheet

Sampling sheet for target neighbour crown assessment

Tree No:			Crown base height:			Angle:	0	45	90	135
Species:			Total tree height:			Width:				
No.ofComp.			HLLB:			Angle:	180	225	270	315
	Min	Max	HLDB:			Width:				
Diameter:			Height max. crown radius							
Azimuth:			dist. horizontal to stem							
			Inclination azimuth							
Neighbor Trees	Tree No.	Species	Distance to FT	Crown width:	Height	HCB	DBH1 (to FT)	DBH2 (perp)	Comments	
Focal Tree	Tree No.	Species	Azimuth	Width	Comments					

Sampling sheet for target tree quality assessment:

Sampling Sheet FUNDIVEUROPE				Date:			
Timber quality and crown parameters							
Site:		Plot:		GPS:			
Nghbrhood:		Species:		Tree ID:			
Tree age:		Tree height:		Taper Sec. 1	Taper Sec. 2	Taper Sec.3	
DBH 1:		DBH 2:					
Height CB:		HLDB:		HLLB:			
Curve 1:		Curve 2:		Kraft class			
Remarks:							
Crown projection area (if needed)							

Angle	0	45	90	135	
	180	225	270	315	
External quality indicators					
< 4 cm			> 4 cm		
Branches	Branch scars	Wounds	Branches	Branch scars	Wounds
Crown Vitality:					
low		medium		high	

Site:		Plot:		GPS:	
Nghbrhood:		Species:		Tree ID:	
Tree age:		Tree height:		Taper Sec. 1	Taper Sec. 2
DBH 1:		DBH 2:			Taper Sec.3
Height CB:		HLDB:		HLLB:	
Curve 1:		Curve 2:			
Remarks:					
Crown projection area					
Angle	0	45	90	135	
	180	225	270	315	
External quality indicators					
< 4 cm			> 4 cm		
Branches	Branch scars	Wounds	Branches	Branch scars	Wounds
Crown Vitality:					
low		medium		high	