

Developing a timber quality model for Scots pine

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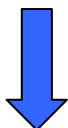
Conifer Breeding and Timber Quality Steering Group
November 27, 2008

Structure

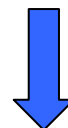
1. Rationale
2. Objectives
3. Timber quality definitions
4. Fieldwork and sampling methodology
5. Analysis
6. Expected outcomes

FOREST POLICY

SILVICULTURAL



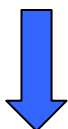
Production
forecast to
peak c. 2020



MANAGEMENT

RESOURCE ASSESSMENT

PREDICTIVE



Timber
volume and
quality
prediction



MODELLING (PhD)

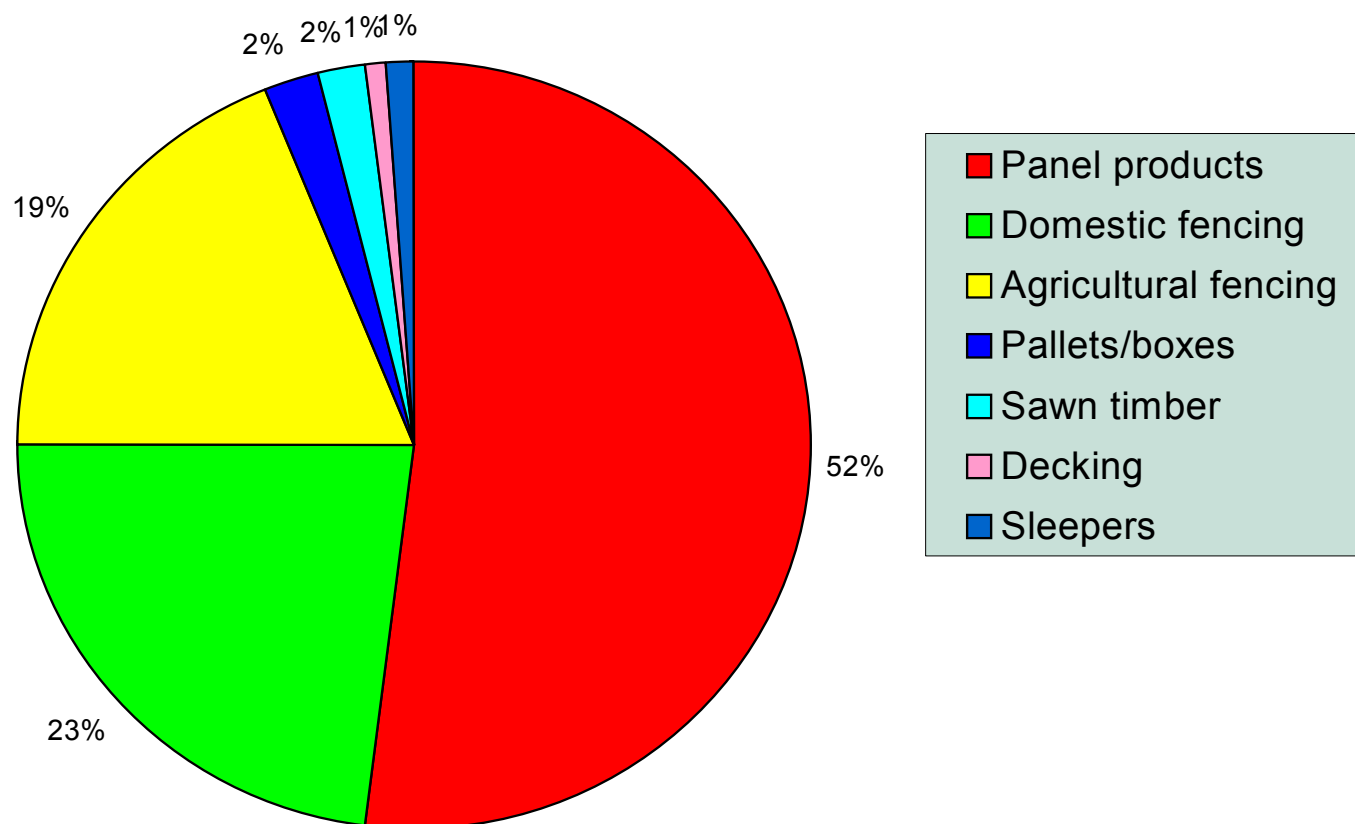
MARKET DEVELOPMENT

ADDED

Increased
use and
profitability of
Scots pine

VALUE

Scots pine: processed timber & products



Total volume: 187700 m³

Source: Forest Research utilisation survey, North Scotland, 2005

Group selection, Culbin Forest, Morayshire



Project Objectives

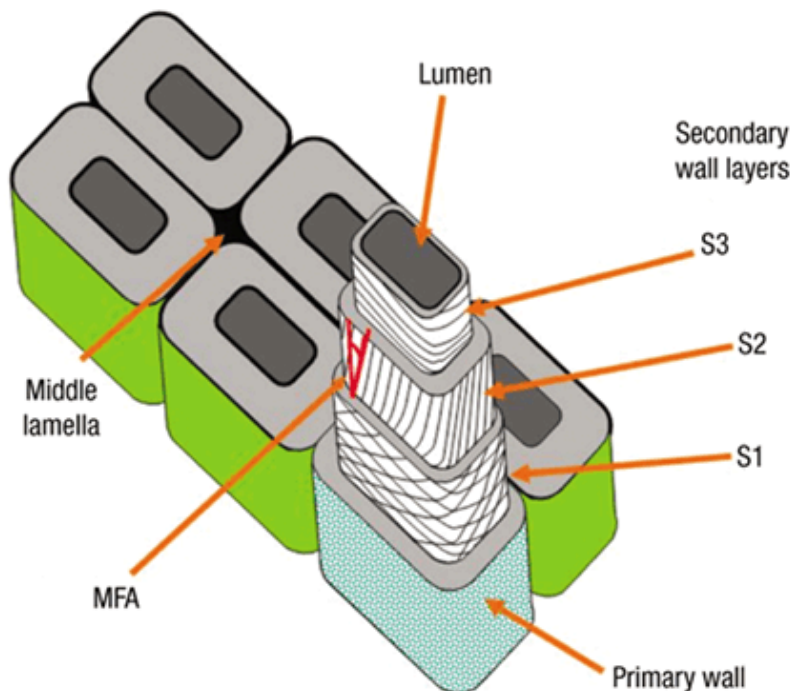
1. To develop Scots pine wood quality models from detailed destructive analysis.
2. To map wood property variation at the level of individual trees.
3. To relate key wood properties to readily available tree characteristics.
4. To predict the effect of silvicultural management on Scots pine timber quality.

Wood Quality

- Variability = no single definition of 'timber quality'.
- 'Fitness-for-purpose' main driver.
- Key wood properties for construction are:
 - Stiffness (MoE)
 - Strength (MoR)
 - Dimensional stability

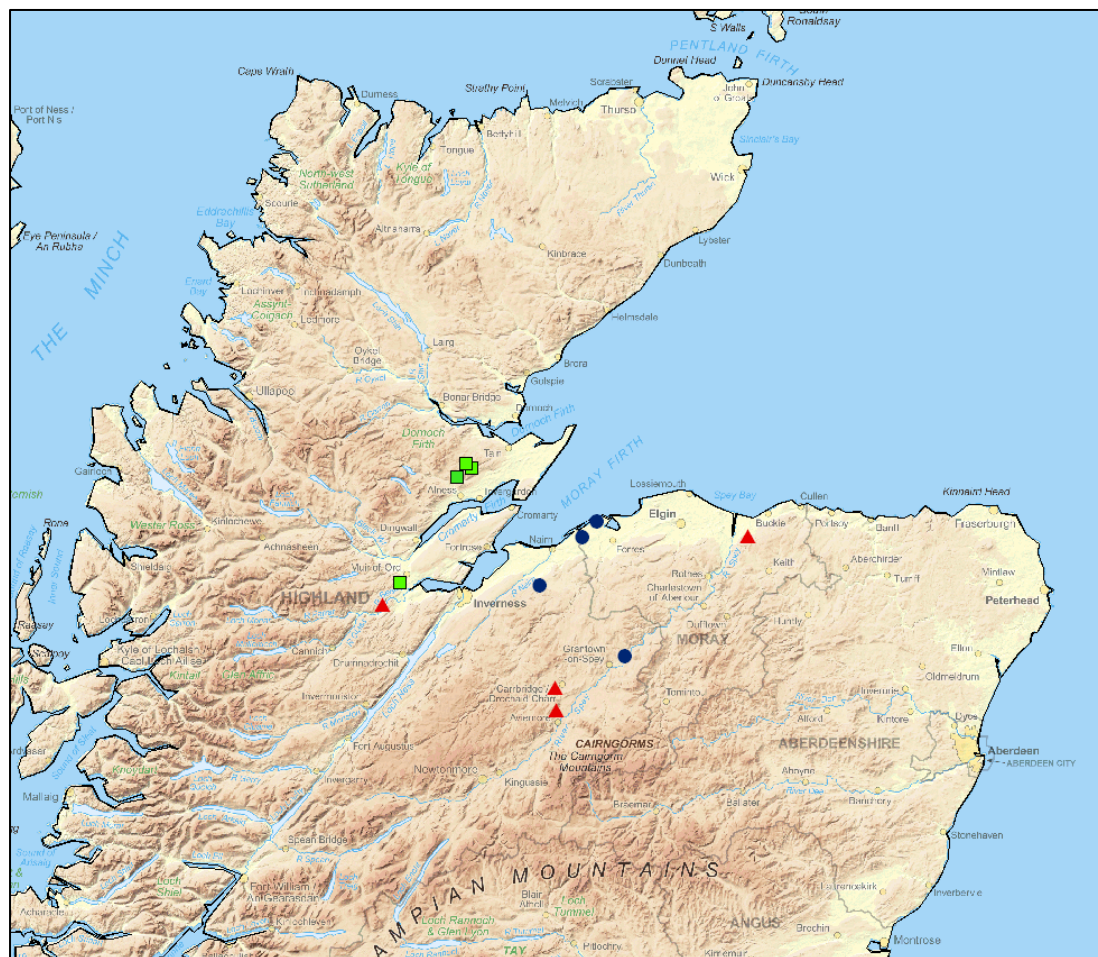


Mechanical Properties



- Influenced by:
 - Density
 - Microfibril angle (MFA)
 - Knots
- Which in turn are influenced by:
 - Site
 - Genetics
 - Silviculture

12 Sample sites



■ Young stands (17-28yrs):

- Kinrive Hill
- Muir of Ord
- Strathroy
- Wallace Hill

▲ Mid-rotation stands (40-50yrs):

- Aigas
 - Avielochan
 - Carr-Bridge
 - Whiteash
- } Unthinned
- } Thinned

● Mature stands (68-90yrs):

- Achneim Wood
- Cloddymoss
- Culbin
- Tomvaich

- YC6 and YC10 in each age class

Site attributes by age-class

<i>Mean Site Attributes</i>	<i>Young Stands</i>	<i>Mid-Rotation (Unthinned)</i>	<i>Mid-Rotation (Thinned)</i>	<i>Mature Stands</i>
<i>Stems ha-1</i>	2070	1840	1510	407
<i>Basal area (m² ha-1)</i>	27.8	51.3	39.7	28.3
<i>DBH (cm)</i>	13.0	18.2	17.7	31.4
<i>Quadratic mean DBH (cm)</i>	13.9	18.8	18.3	32.9
<i>Stand age (years)</i>	24.3	44.5	47.0	77.8
<i>ST300 acoustic velocity (km s-1)</i>	3.44	3.74	4.13	4.23

Tomvaich Wood, Strathspey
(Seafeld Estate: P1925)



Aigas 2536-A1, Inverness-shire
(FC: P1966)



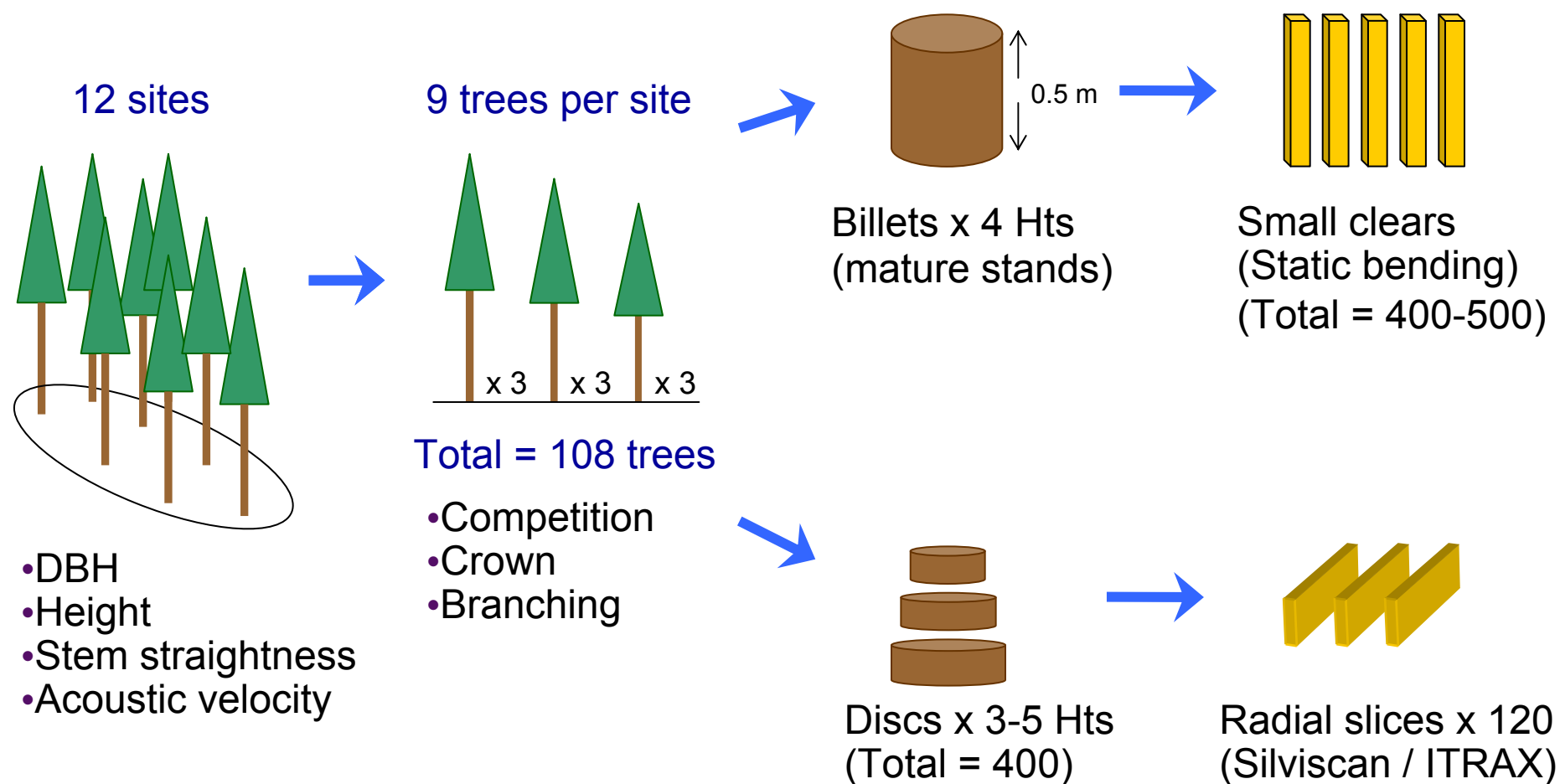
Strathrory 159-A1, Easter Ross
(FC: P1983)



Whiteash 1196-A1, Morayshire
(FC: P1963)

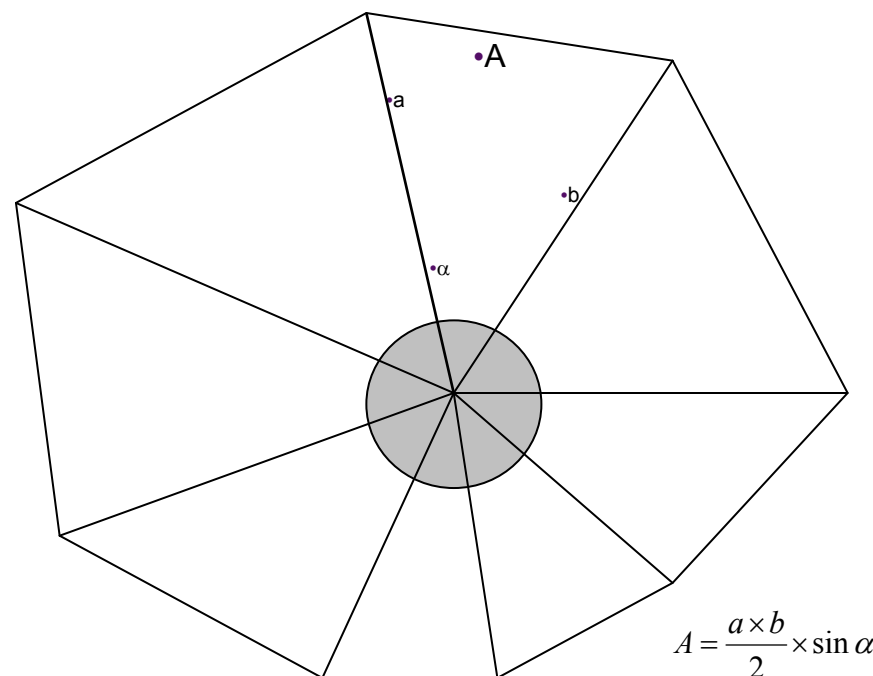


Sampling methodology



Sample tree measurements

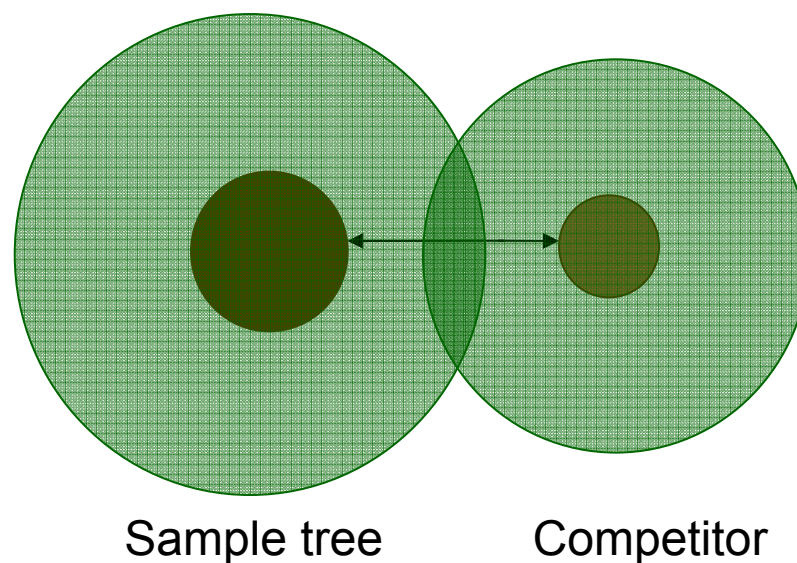
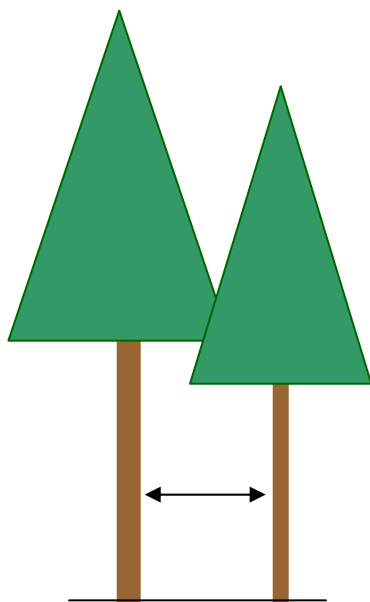
Crown projection area:



$$A = \frac{a \times b}{2} \times \sin \alpha$$

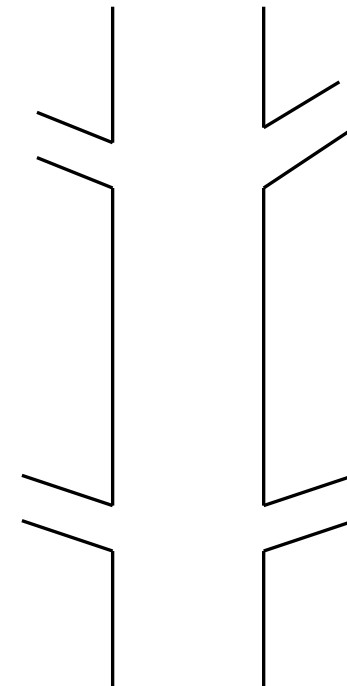
Sample tree measurements

Competition index – size and proximity of competing trees



Sample tree measurements

Detailed branching measurements (66 trees):
Branch number, size, angle, status, position.



Knot distribution

Destructive testing



3-point bending tests (MoE and MOR)



Ring analysis (WinDENDRO)

Fine-scale measurements



Silviscan-3 diffractometer (STFI, Sweden):

- Density
- Tracheid dimensions
- EW: LW ratio
- MFA

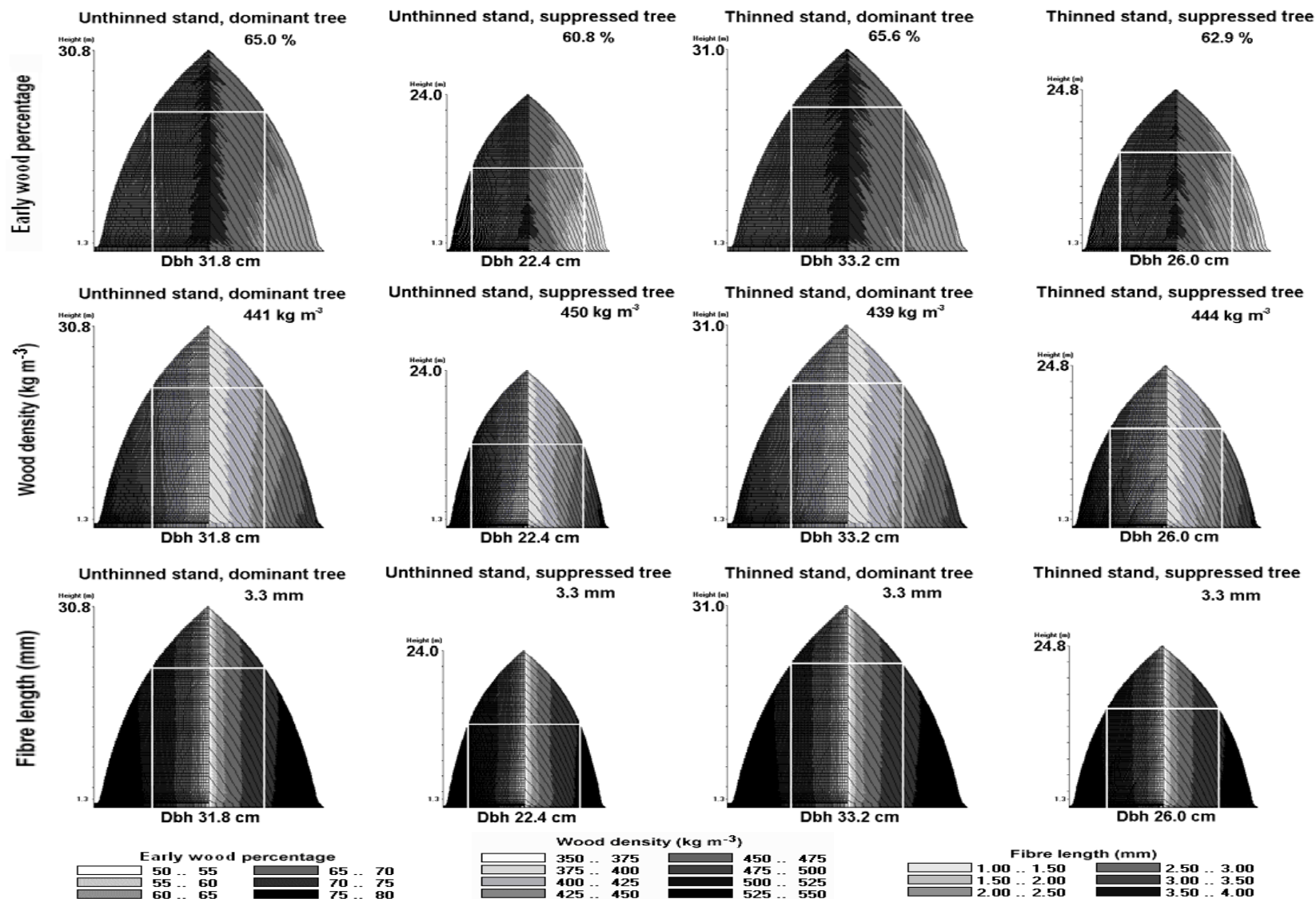


ITRAX X-ray densitometer
(Glasgow University):

- EW width
- LW width
- EW density
- LW density
- Ring density

Analysis

- Linear and non-linear mixed modelling techniques.
- Models to be developed for:
 - Branching (number, size, angle, mortality, self-pruning).
 - Wood stiffness and strength (MoE, MoR), density, % latewood and tracheid dimensions.
 - Link to growth model outputs for prediction of effects of management on wood quality



Images courtesy (Ikonen *et al.* 2008), University of Joensuu, Finland

Expected outcomes

- Quantification of the tree-level variation of wood properties in locally-grown Scots pine.
- Improved understanding of the effects of silviculture on future timber quality and construction grade timber production.
- The developed models will be applicable to alternative silvicultural systems i.e. irregular structures.

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- Steve Conolly – Cawdor Forestry Ltd.

Thanks!

Site Attributes

	Young Stands				Mid-rotation - Unthinned		Mid-rotation - Thinned		Mature Stands			
	Kinrive Hill	Muir of Ord	Strathrory	Wallace Hill	Avie- lochan	Aigas	Carr- Bridge	Whiteash	Achneim	Cloddy- moss	Culbin	Tomvaich
Site ID	KN	MO	ST	WH	AL	AG	CB	WA	AC	CM	CU	TV
Latitude N°	57° 45'	57° 30'	57° 46'	57° 44'	57° 13'	57° 26'	57° 16'	57° 37'	57° 31'	57° 36'	57° 39'	57° 21'
Longitude W°	4° 12'	4° 39'	4° 14'	4° 15'	3° 49'	4° 33'	3° 49'	3° 02'	3° 55'	3° 45'	3° 40'	3° 33'
Elevation (m)	250	150	180	160	280	200	300	50	90	10	10	220
DAMS Score	13	11	10	12	10	13	14	12	13	12	12	14
Cumulative Temp.												
Soil Type												
Planting Year	1981	1991	1983	1980	1962	1966	1959	1963	1935	1940	1928	1925
Area (ha)	4.5	4.2	4.5	4.2	3.5	7.2	8.9	3.1	3.5	4.1	3.7	5.0
Quadratic mean DBH	13.2	7.4	16.6	14.9	17.3	20.4	18.1	18.5	37.0	22.9	26.9	40.3
Stems per hectare	1630	2660	1970	2020	1920	1760	1450	1570	300	575	535	210
Basal Area (m² ha⁻¹)	22.22	11.38	42.51	35.28	45.32	57.24	37.03	42.31	32.76	23.42	30.18	26.72
Top Height (m)	12.0	7.0	13.4	13.3	14.6	17.2	13.7	17.4	23.2	17.0	19.0	25.7
Yield Class	6	10	6	10	8	10	6	10	10	6	6	10
AVG ST300 Velocity	NA	NA	3.20	3.75	3.84	3.64	3.96	4.31	4.07	4.61	4.09	4.25
Forest Owner	FC	FC	FC	FC	Seafield	FC	Seafield	FC	Cawdor	FC	FC	Seafield