Ireland's NFI

Field Map Users Conference
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An Roinn Talmhaíochta, Bia agus Mara

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Introduction

- Overview
- Sampling design and air photo-interpretation
- NFI technology
- Data collection
- Data processing
- NFI results

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Overview

The National Forest Inventory (NFI) is a statistical sample survey of all forests in the state.

Objective

The purpose of the NFI is to record and assess the current extent, state, composition of and change to Ireland's forest resource, both public and private, in a timely, accurate and reproducible manner to enable the sustainable development of our forest resource.

Primary Output

Provide results at a national level, with reliability estimates based on the 95% confidence interval, specifically in relation to:

Growing stock;	Forest area;	Harvesting;
Increment;	Carbon;	Species composition;
Forest biodiversity;	Forest health and vitality.	

Timeline

Approximately 5-6 year periodic NFI based on permanent sample plots:

NFI 1: 2004-2006	NFI 2: 2009-2012	NFI 3: 2015-2017

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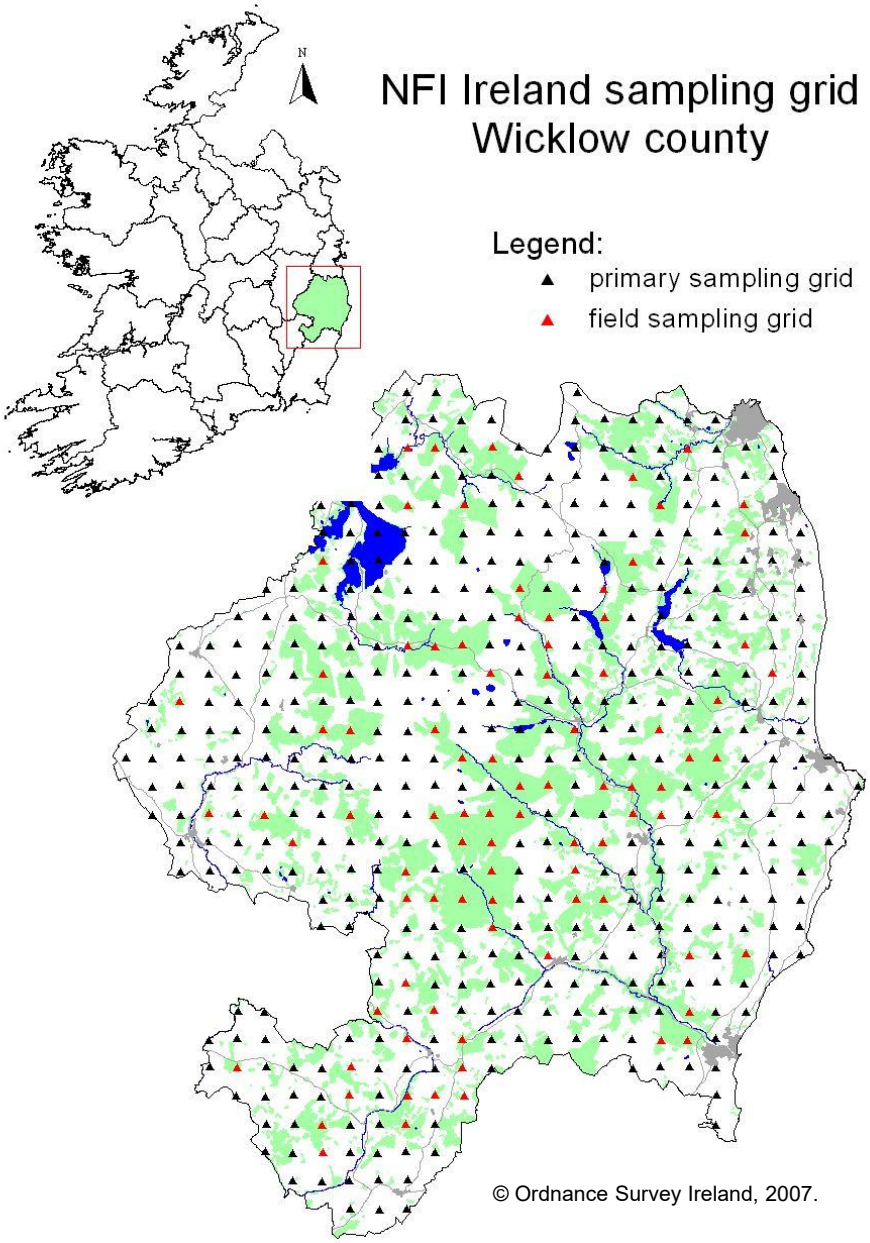
NFI Sampling Design



2k x 2k systematic randomised grid.

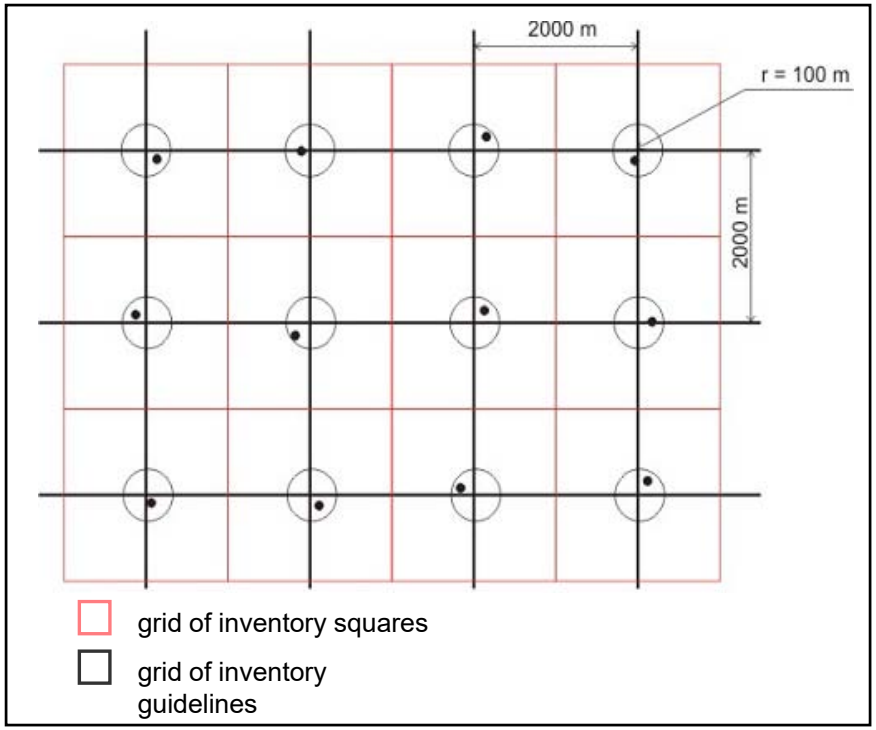


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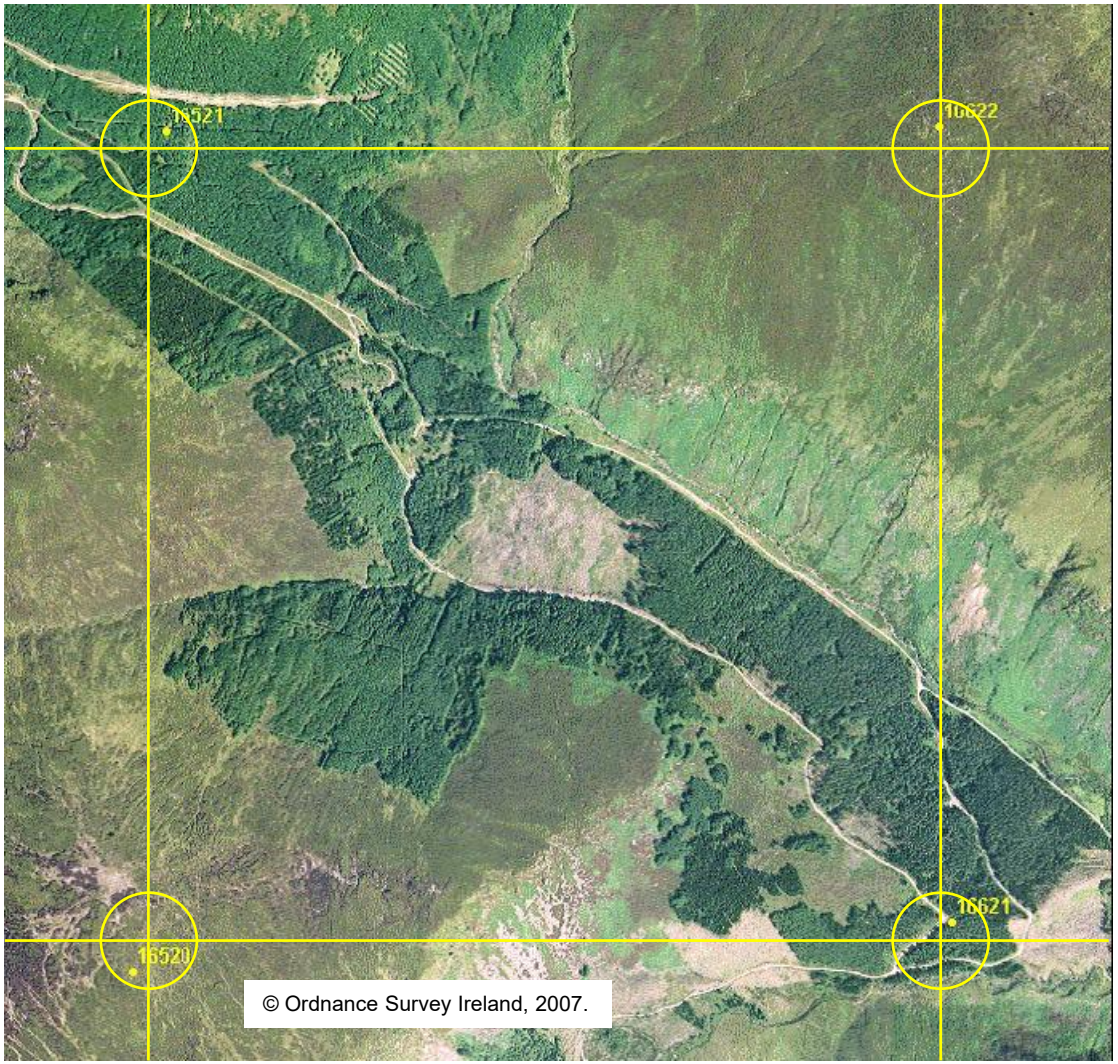
Photo-interpretation

- Air photos
  - 2004-2006 1m res
  - 2011-2013 30cm res
- Datasets
  - Wire-frame format
- Result
  - 1800 Ground sample plots
  - LUT classification



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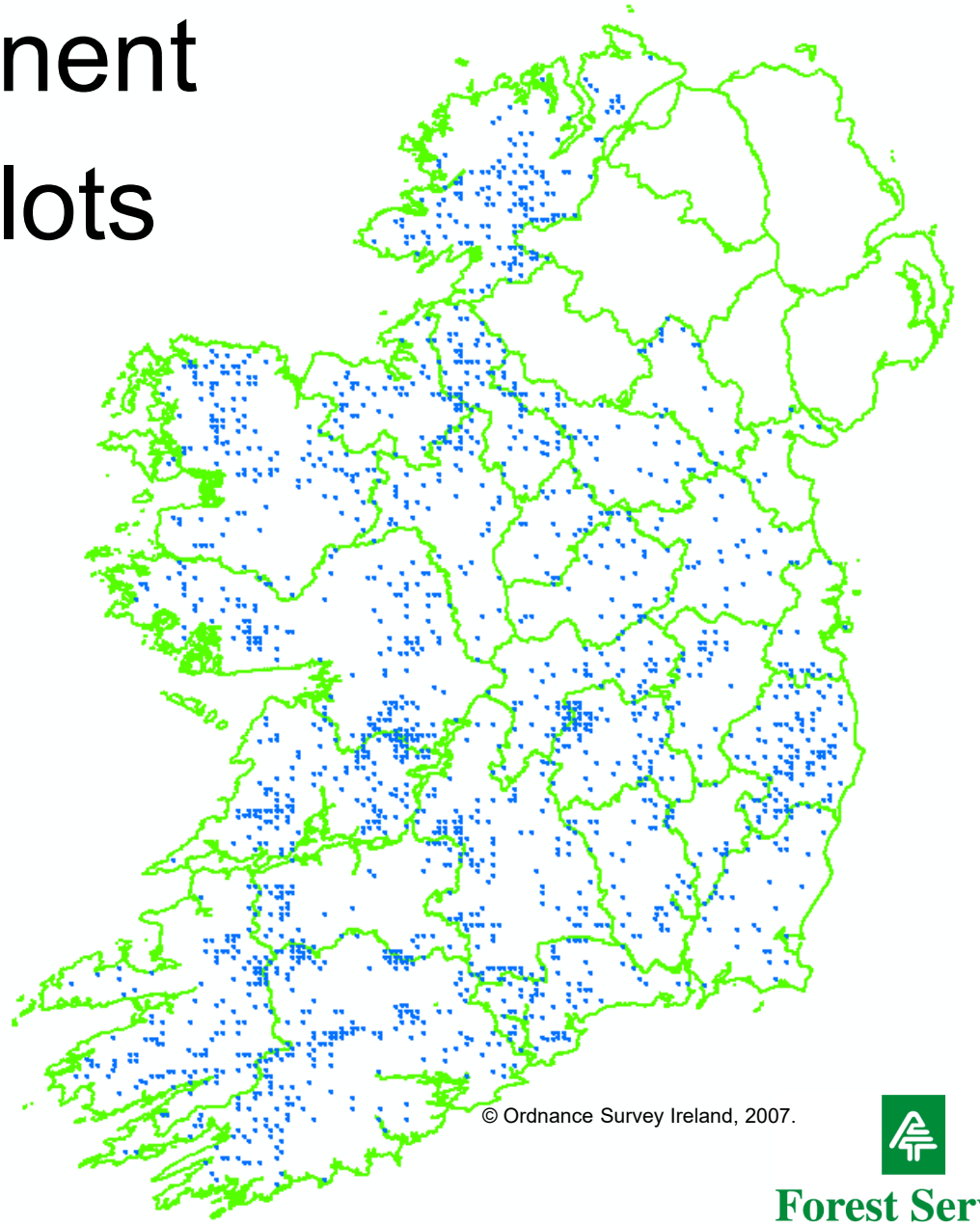
NFI permanent sample plots



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Definitions

Forest

Land with a minimum area of 0.1 hectare, a minimum width of 20 m, trees higher than 5 m and canopy cover of more than 20% within the forest boundary, or trees able to reach these thresholds *in situ.*

Forest Open Area

A non-stocked area enclosed within the forest boundary, e.g. ride-lines, setback from stream, etc.

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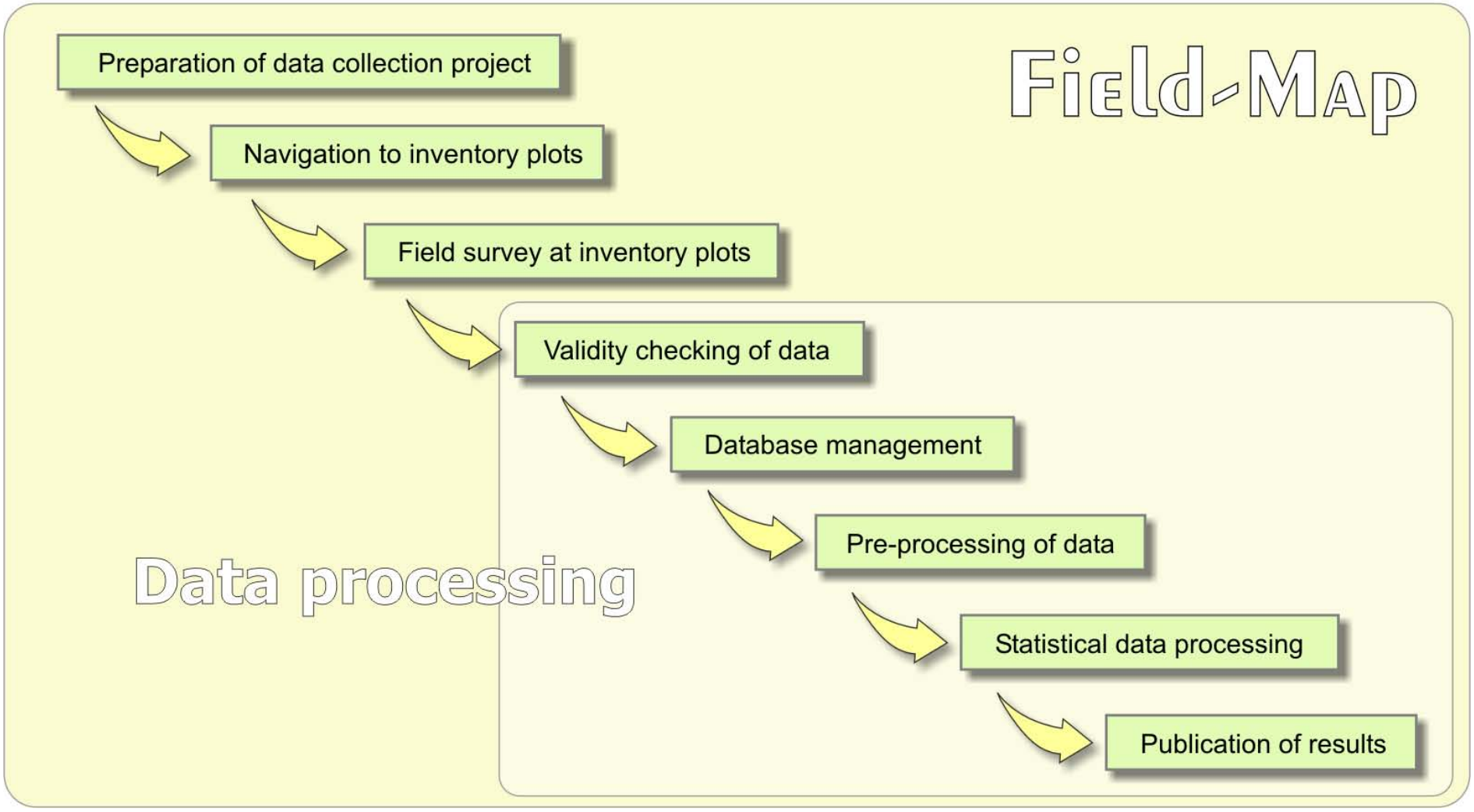
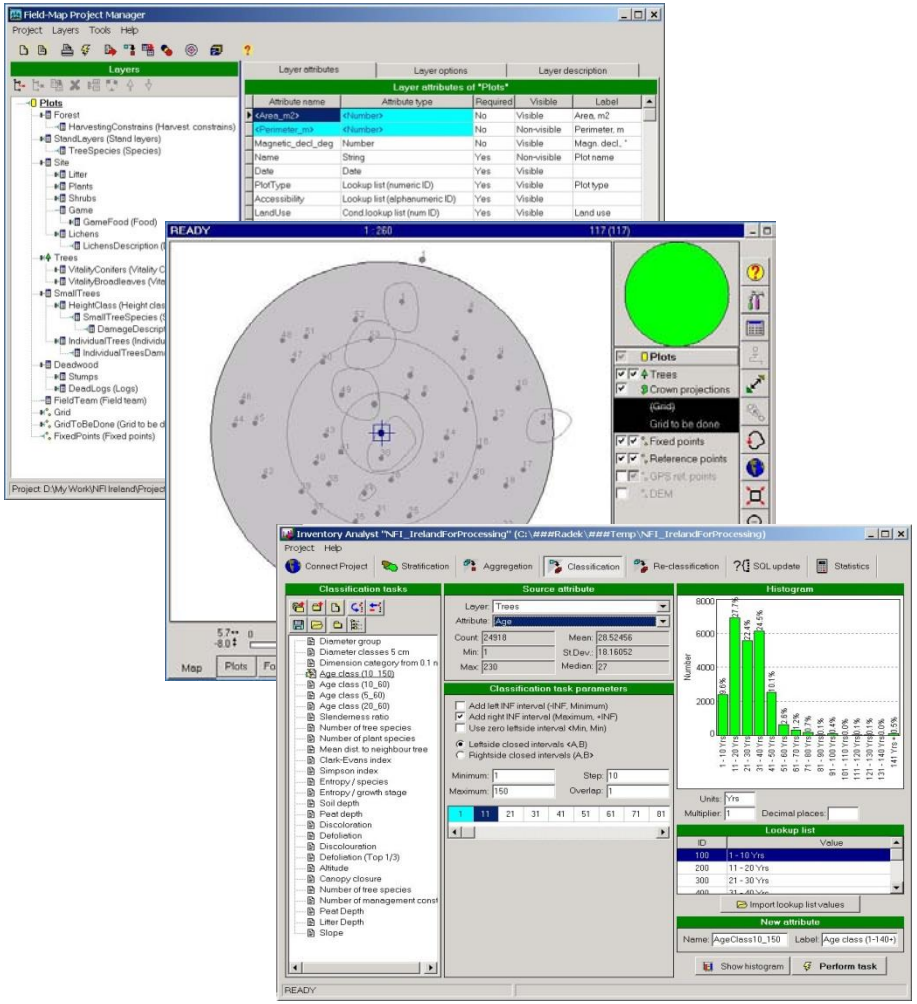
NFI
Technology

NFI technology

Integrated system



Technology
Software



- Field-Map Project Manager
  - creating/changing database structure
  - database management
  - preparation of background maps
  - data check
  - data export

- Field-Map Data Collector
  - data collection (mapping, attributing)
  - on-line communication with electronic equipment
  - data check
  - data import

- Field-Map Inventory Analyst
  - data processing

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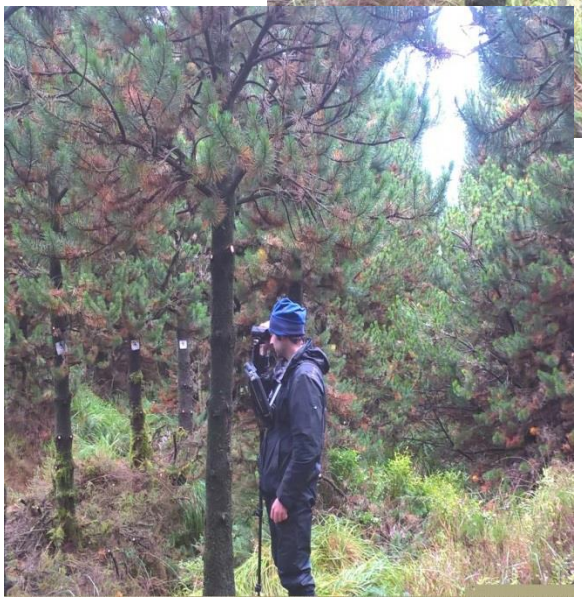
Technology
Hardware

Basic components

Computer:	Hammerhead XRT.
GPS:	SX Blue II
Laser/compass:	TruPulse 360R

Accessories:

Harness
Monopod
Cables&batteries
Rechargers
Port replicator
Scope
Slash hook, saw
…



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Data Collection

Data Collection

- 1800 permanent sample plots
- 145 Atrributes/plot
- 3 two person teams
- 20 months including training
- Year round data collection

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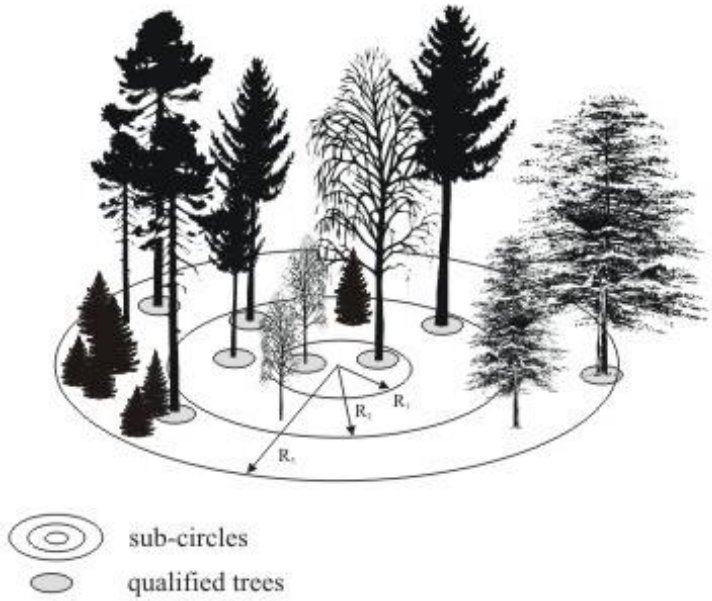
Plot design

Scheme of inventory plot



- reducing workload and working time necessary to finish the inventory plot

- tree qualifies if its position and diameter at breast height fulfils defined limits

	R_1	R_2	R_3
Sub-circle radius (m)	4.00	7.00	12.62
Sub-circle area (m^2)	50.3	153.9	500.0
Threshold Dbh (mm)	70	120	200

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Database structure

Basic scheme

- fully hierarchical structure
- 29 tables and 145 attributes
- field database in firebird and GIS part in ESRI shapefile
- Field-Map exports data into MS Access, dBase, MS Excel, XML

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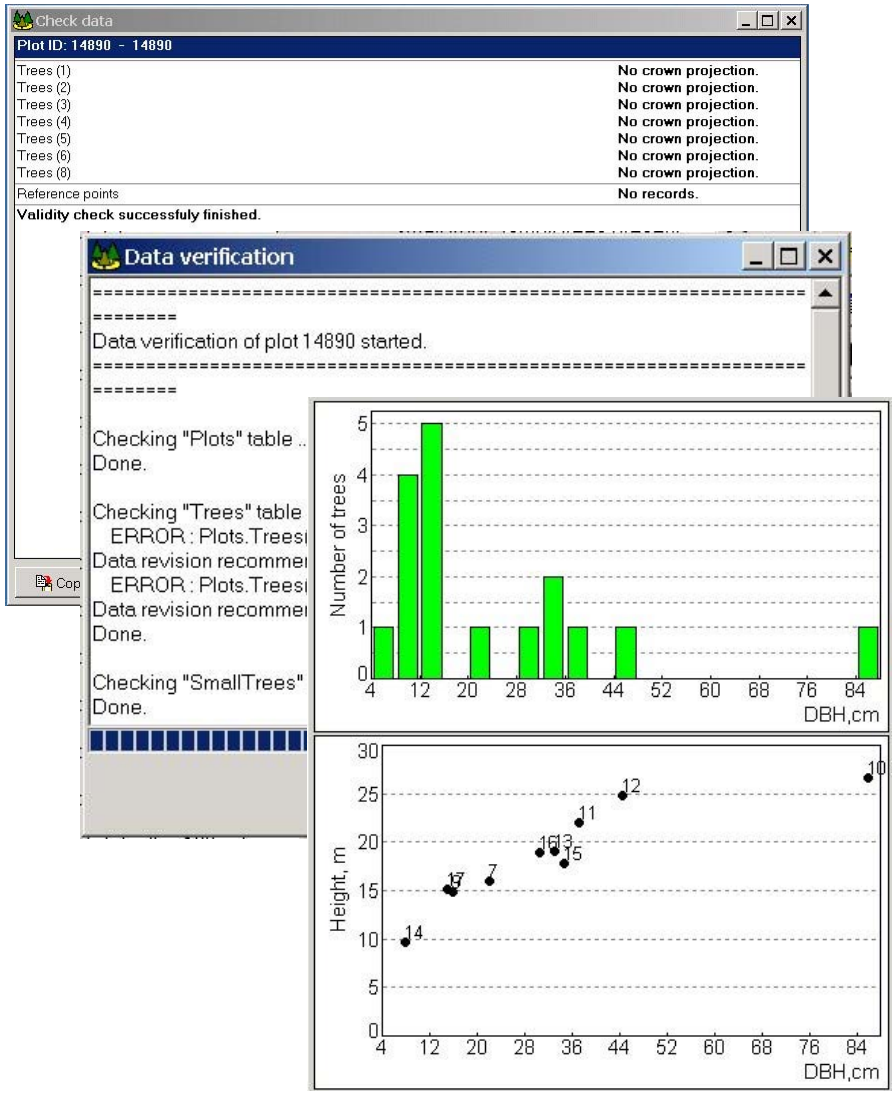
Data collection

Data check



Data check:
Prior leaving the inventory plot, the operator performs a comprehensive data checks, including:

- **missing data check** … Field-Map searches for all missing information which are required and list missing items in “Check data” output file
- **data verification script** … Field-Map checks defined logical relations and list errors or “possible errors” in “Data verification” output file
- **visual check** … visual check of DBH distribution and Height x DBH graphs
- operator inputs missing or corrects wrong information identified during data check procedure

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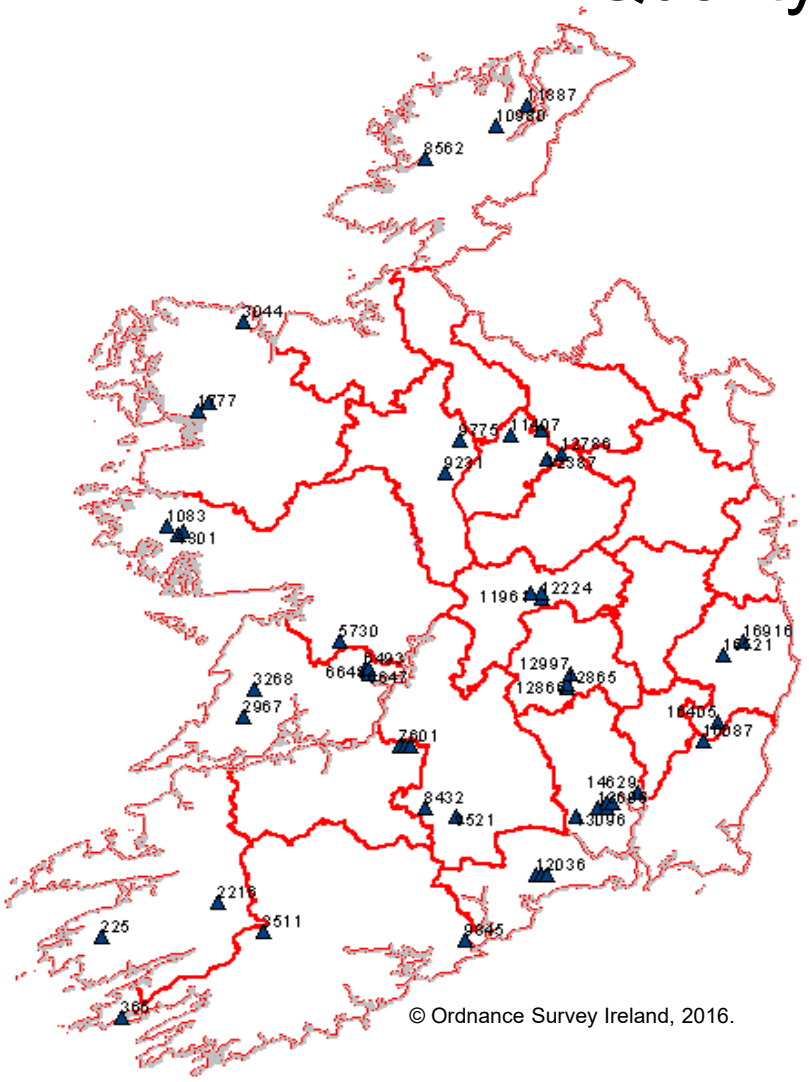
Data validation

Quality assurance



Validation:

- Joint IFER/FS validation team
- Custom designed validation software
- 100 plots randomly selected

Actions

- Plot remeasurement
- Field team update
- Project management

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Data Processing

Data pre-processing
Methods

- Modeling (e.g. tree volume)
- Classification (e.g. diameter classes)
- Aggregation (e.g. number of species per plot)
- Re-classification (e.g. species groups)
- Post-stratification (e.g. by counties)

Volume Models

- NFI 1(2004-2006): British Forestry Commission single tree volume equations (Matthews and Mackie)

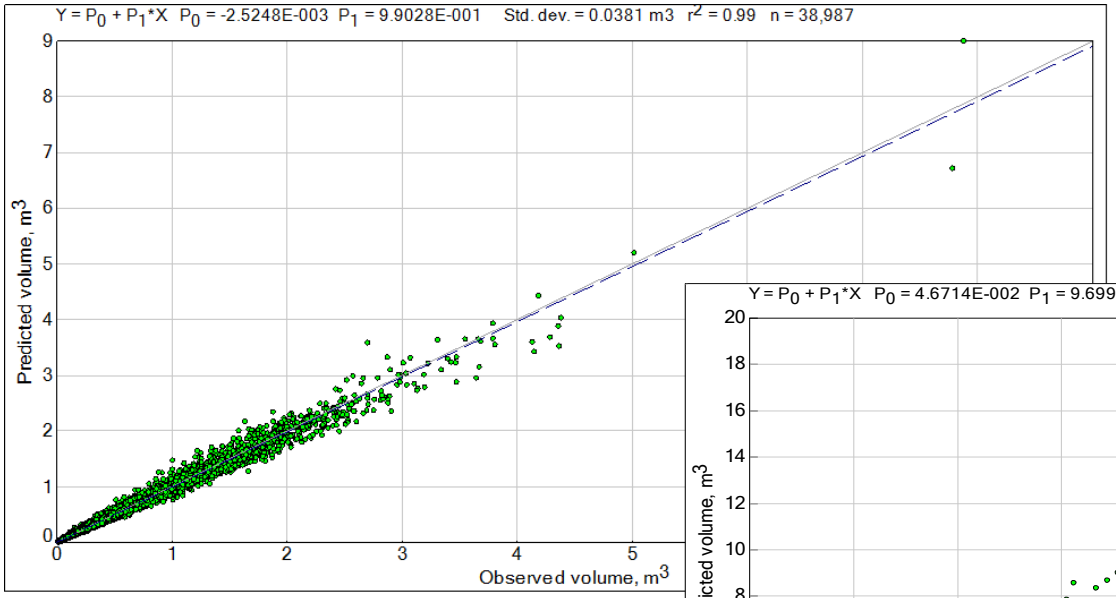
- NFI 2 (2009-2012):

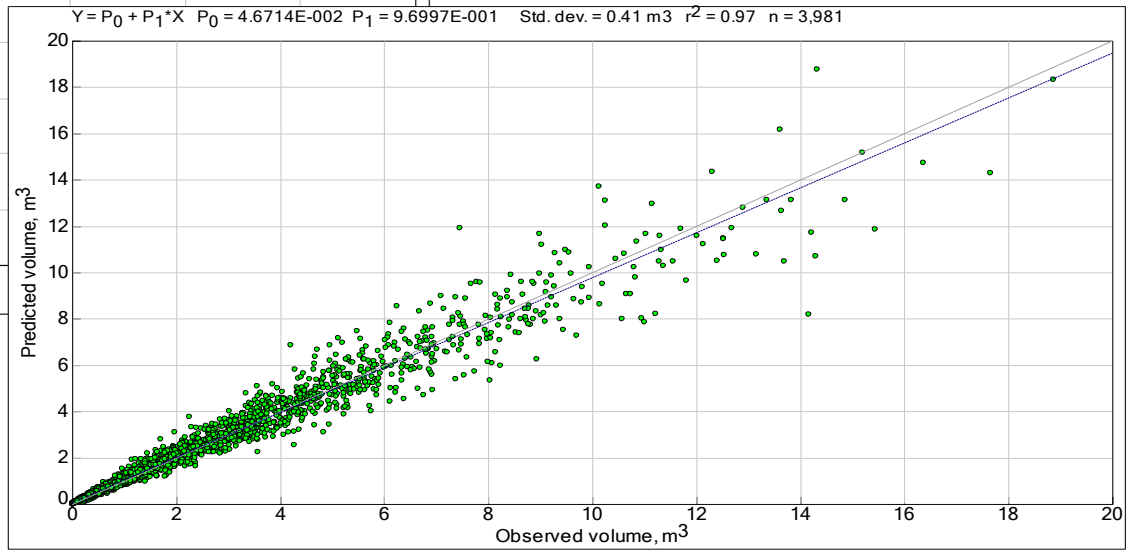
  -Single tree stem profile Models for 6 conifer spp. - historic data from destructive sampling.

  -Single tree stem profile Models for 4 broadleaf spp.- 2013 data acquired by non-destructive sampling – remote diameter scope & Field Map Stem Analyst.

  The new models use the explanatory variables of DBH & Height to generate volume.

Volume Models





The performance of both conifer and broadleaf models was very good: R^2 0.99 & 0.97 respectively

Statistical data processing

Basic Terms

- Evaluated variable
  (area, volume, number of trees)

- Stratifier
  (post-stratification decreasing variance)

- Classifier
  (species, diameter classes, soil groups, etc.)

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Calculated statistics

- Totals
  (total area, total volume, etc.)
- Mean values
  (mean volume, mean height, mean defoliation, etc.)
  - Mean of totals
  - Mean of means
  - Mean of weighted means
  - Normalised mean of totals
  - Normalised mean of weighted means
- Confidence interval (α=0.05)

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NFI Results
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Standardised outputs

Tables

Classes

Calculated statistics (total)

Confidence interval

Percentage

Species group	County / Volume (BFC ground to 7cm)								
	Wicklow			Kerry			Total		
	1000 m^3	($\alpha = 0.05$)	%	1000 m^3	($\alpha = 0.05$)	%	1000 m^3	($\alpha = 0.05$)	%
Sitka spruce	2 458.7	(1 628.8 – 3 288.5)	59.9	2 938.1	(2 126.6 – 3 749.6)	53.1	5 396.8	(4 266.2 – 6 527.3)	56.0
Norway spruce	248.7	(0.0 – 2 861.9)	6.1	–	–	–	248.7	(0.0 – 2 861.9)	2.6
pine	60.2	(0.0 – 143.1)	1.5	1 095.4	(0.0 – 2 377.2)	19.8	1 155.5	(0.0 – 2 438.1)	12.0
Douglas fir	116.9	(0.0 – 302.5)	2.9	–	–	–	116.9	(0.0 – 302.5)	1.2
larch	168.6	(0.0 – 346.9)	4.1	2.8	–	0.05	171.4	(0.0 – 349.7)	1.8
other conifers	149.6	(86.4 – 212.7)	3.7	155.5	(0.0 – 1 257.8)	2.8	305.1	(0.0 – 1 409.1)	3.2
oak	468.8	(63.7 – 873.9)	11.4	438.3	(159.6 – 716.9)	7.9	907.1	(445.5 – 1 368.6)	9.4
beech	272.9	(0.0 – 577.7)	6.7	50.8	(0.0 – 164.1)	0.9	323.7	(1.4 – 646.0)	3.4
ash	56.6	(8.0 – 105.2)	1.4	48.7	(10.4 – 87.1)	0.9	105.3	(43.4 – 167.2)	1.1
birch	50.5	(0.0 – 147.6)	1.2	336.5	(67.2 – 605.8)	6.1	387.0	(116.0 – 657.9)	4.0
alder	30.6	– –	0.7	118.0	(55.5 – 180.6)	2.1	148.7	(86.1 – 211.2)	1.5
other long living broadleaves	7.6	(0.0 – 15.5)	0.2	235.3	(20.5 – 450.0)	4.3	242.8	(28.1 – 457.6)	2.5
other short living broadleaves	8.3	(0.0 – 29.8)	0.2	112.1	(16.1 – 208.2)	2.0	120.5	(24.3 – 216.7)	1.3
Total	4 097.8	(3 094.9 – 5 100.7)	100.0	5 531.6	(4 110.0 – 6 953.2)	100.0	9 629.4	(7 909.7 – 11 349.1)	100.0

Totals, sub-totals

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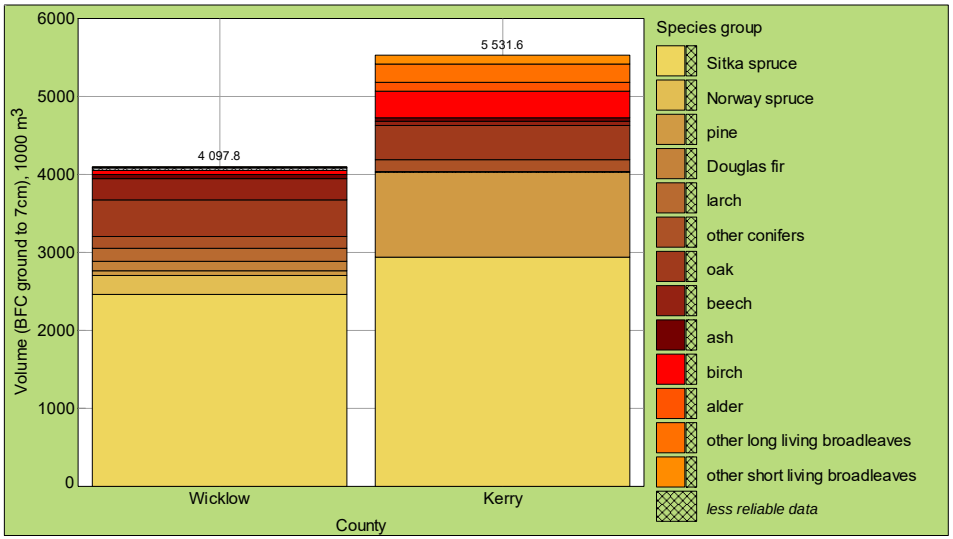
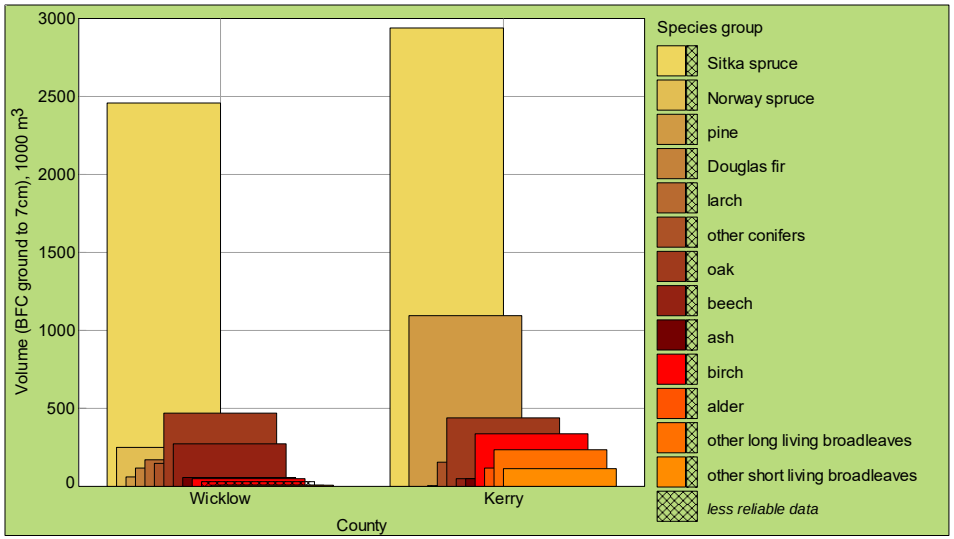
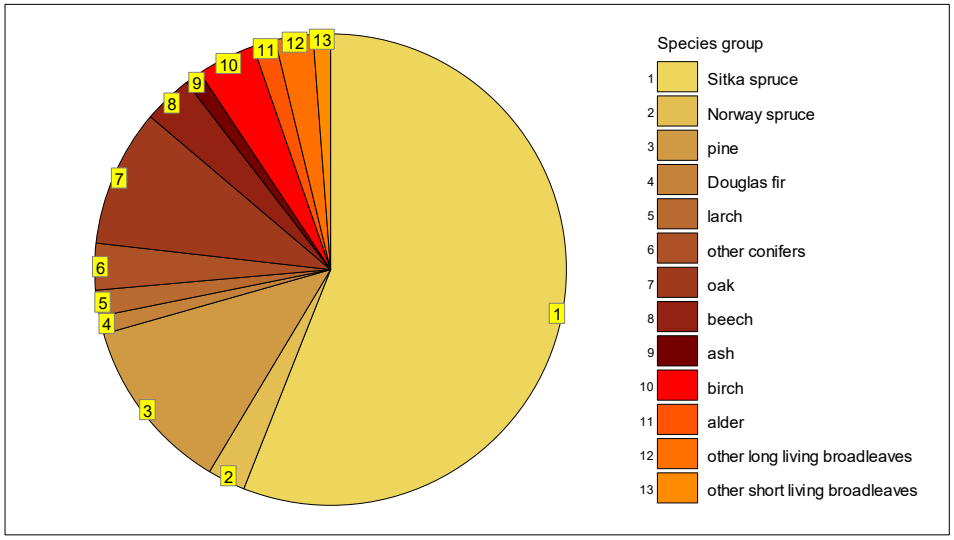
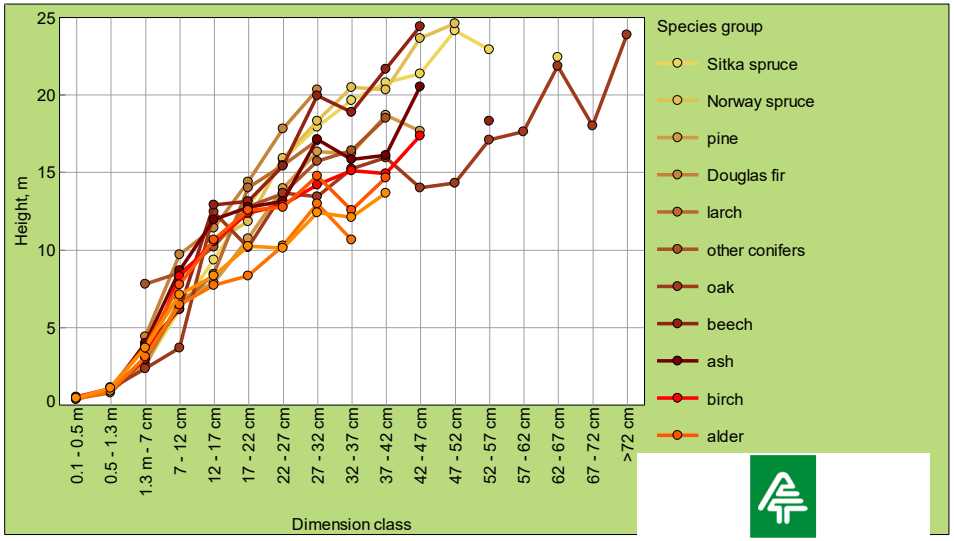
Standardised outputs

Charts









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Land-use category Change 2006 - 2012

	2006			2012		
	Area (ha)	95% C.I.	%	Area (ha)	95% C.I.	%
Forest	697,842	(666,650 - 728,810)	10	731,652	(700,053-763,251)	10.5
Non-forest	6,278,270	(6,247,320 - 6,309,22)	90	6,244,460	(6,212,861-6,276,059)	89.5
Total	6,976,112		100	6,976,112		100

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Ownership

	2006			2012		
Ownership	Area (ha)	95% C.I.	%	Area (ha)	95% C.I.	%
Public	397,463	(381,490 - 413,44)	57.0	389,356	(365,679-413,038)	53.2
Private	300,380	(284,400 - 315,350)	43.0	342,300	(319,970-364,620)	46.8
Total	697,843		100.0	731,656		100.0

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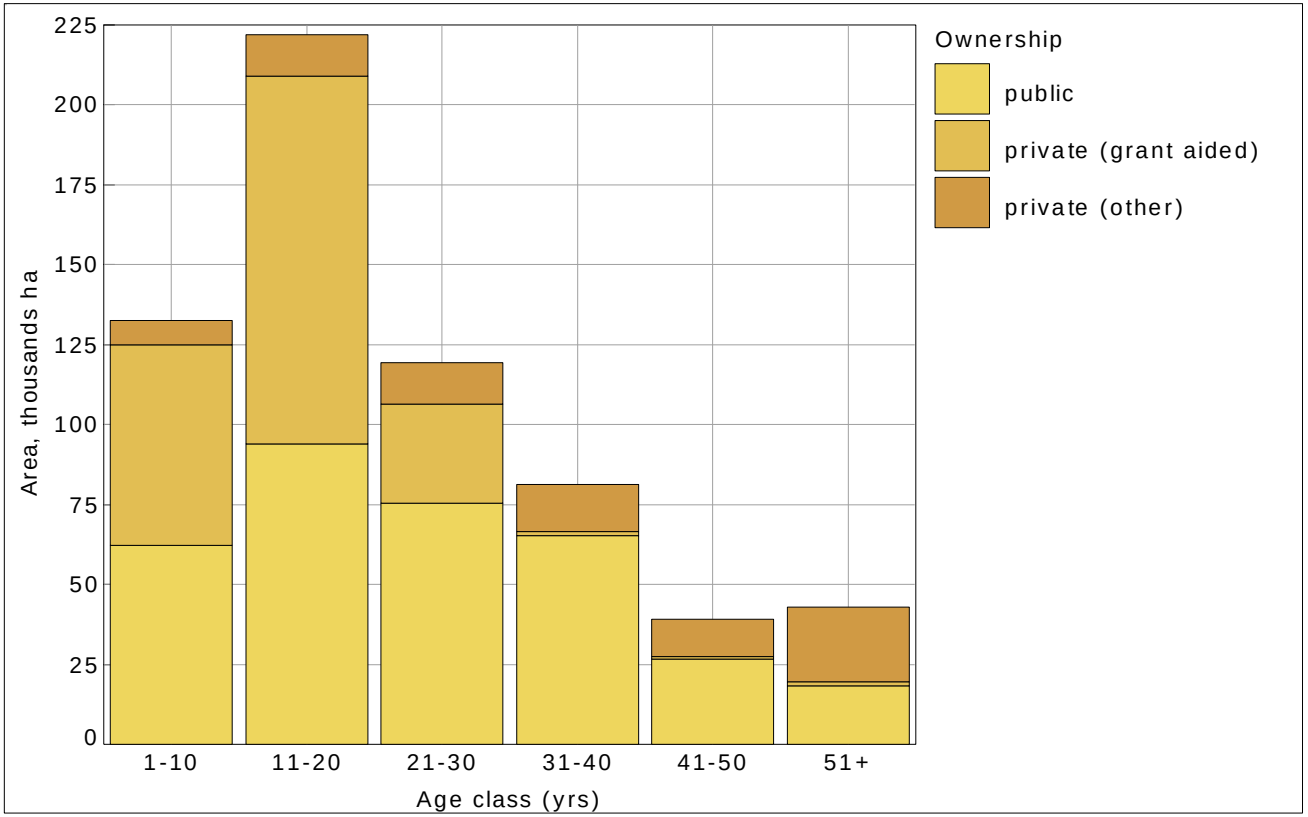
Age-class 2012



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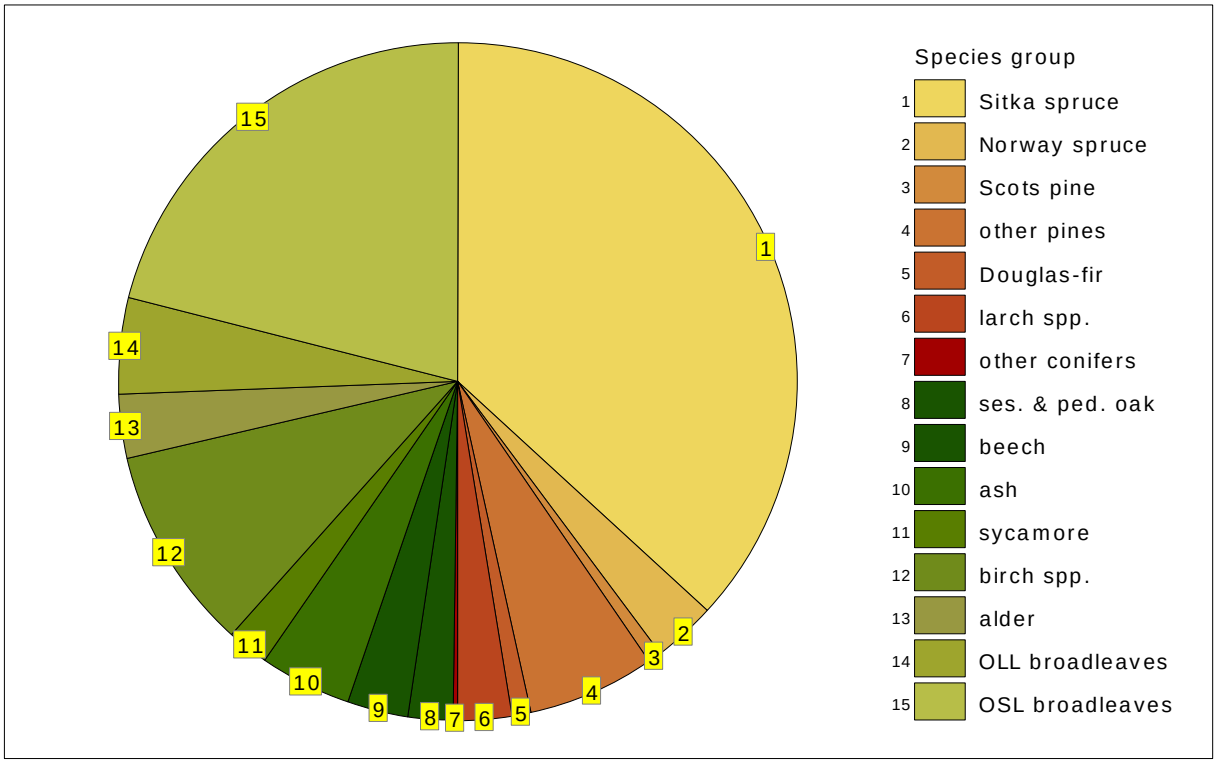
Species composition 2012



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Growing stock Change 2006-2012

	2006			2012		
	1000's m^3	95% C.I.	%	1000's m^3	95% C.I.	%
Public	51,713	(48,628-54,797)	72	60,405	(56,794 - 64,016)	62
Private	20,147	(18,155-22,138)	28	37,071	(34,398 - 39,743)	38
Total	71,860	(68,178-75,542)	100	97,476	(92,906-102,046)	100

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Growing stock by species group 2012

Species group	Growing stock		
	thousands m^3	($\alpha = 0.05$)	%
Sitka spruce	57,555.2	(53,902.5 – 61,207.9)	59.0
Norway spruce	3,981.6	(3,194.7 – 4,768.6)	4.1
Scots pine	1,056.4	(777.3 – 1,335.4)	1.1
other pines	9,457.6	(7,968.1 – 10,947.1)	9.7
Douglas-fir	2,621.5	(2,051.8 – 3,191.2)	2.7
larch spp.	3,440.8	(2,621.4 – 4,260.2)	3.5
other conifers	1,676.2	(711.3 – 2,641.2)	1.7
ses. & ped. oak	3,509.8	(2,647.6 – 4,372.0)	3.6
beech	2,775.1	(1,891.4 – 3,658.8)	2.8
ash	2,393.0	(1,958.5 – 2,827.6)	2.5
sycamore	1,019.8	(578.5 – 1,461.1)	1.0
birch spp.	3,073.2	(2,609.5 – 3,537.0)	3.2
alder	1,332.1	(974.0 – 1,690.2)	1.4
OLL broadleaves	1,379.3	(0.0 – 2,910.3)	1.4
OSL broadleaves	2,204.5	(1,815.9 – 2,593.2)	2.3
Total	97,476.3	(92,906.4 – 102,046.1)	100.0

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Mean growing stock per hectare 2012

	2012	
	m^3/ha	95% C.I.
Public	169	(158 - 180)
Private (grant aided)	127	(117-137)
Total	148	(140 - 156)

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Mean Annual Increment 2006 -2012

Ownership	Annual Volume Increment		
	1000's m^3	95% C.I.	% Total
Public	4,706	(4440 - 4972)	61.2
Private	2,979	(2760 - 3198)	38.8
Total	7,685		100

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Mean Annual Standing Volume harvested 2006 -2012

Ownership	1000's m^3	95% C.I.	%
Public	3,163	(2,532 - 3,793)	87.5
Private (grant aided)	453	(273 - 633)	12.5
Total	3,637	(2,960 - 4,271)	100.0

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Thank You

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