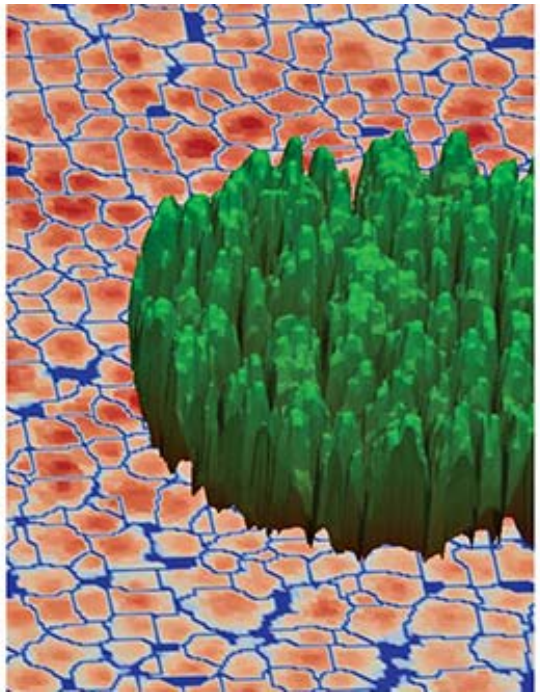
Growing confidence in forestry's future Research Programme

SCION forests · products · innovation

Long term site productivity trials – What happened to the soil resources?

Loretta Garrett, Peter Clinton, Peter Beets, Mark Kimberley, Simeon Smaill



forestgrowers levy trust inc Funding Support Provided by the Forest Growers Levy Trust

FOREST OWNERS ASSOCIATION

Outline

- Soil and forest productivity
- Long-term sustainable productivity trials
- Woodhill soil results
- Summary

Growing confidence in forestry's future Research Programme 2013-2019

Are changes to soil productivity being hidden?

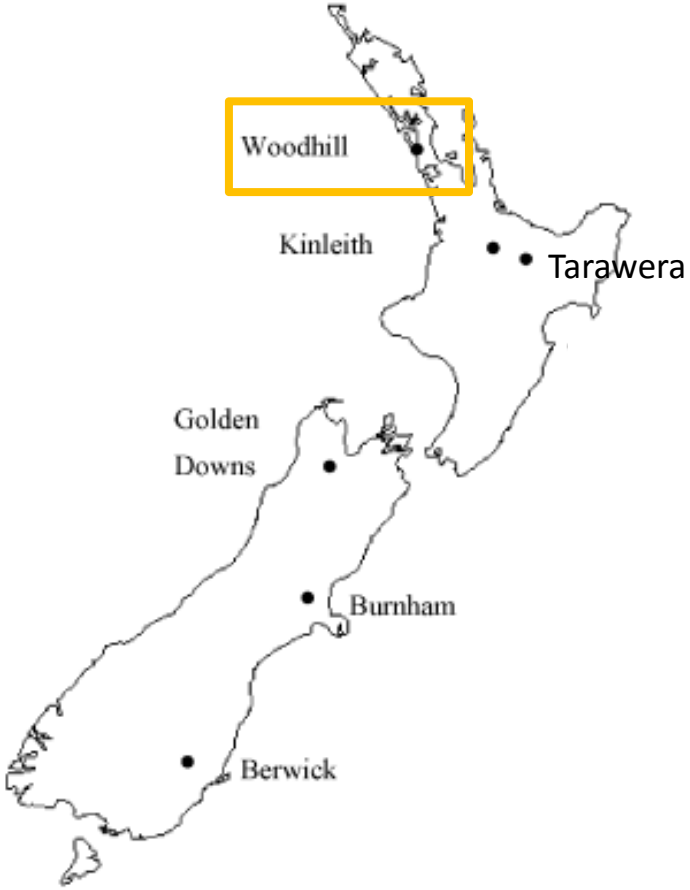
Forest Productivity	=	Internal Factors - genotype	x	External Factors - climate - soils	x	Silvicultural Management - weed control - irrigation
1st Rotation Yield	=	Gene activity	x	Site nutrition	x	Weed competition

Benchmarks productivity for this site

		Genetic gain		**Nutrient loss**		**Better products**
2nd Rotation Yield	=	+20%	x	-20%	x	+15%

Long-term sustainable productivity trials

- Organic matter removal
- Fertiliser amendment
- 6 sites, established 1986



Woodhill long-term trial

1985
End of 1st rotation

2014
End of 2nd rotation

Treatments	Treatment Description
Harvest removal management ↓	Addition of double the amount of slash
	Stem only removed
	Whole tree removed
	Whole tree + Forest Floor removed
Fertiliser management	± Fertiliser application (dominantly N)

Woodhill tree results – 2014

Age when trees achieved a mean DBH of 35 cm for unfertilised harvesting treatments

- Unfertilised FF (forest floor removed) treatment took 3 years longer to reach 35 cm DBH than other unfertilised treatments

Reduction in time required to reach a mean DBH of 35 cm achieved by fertilising for each harvesting treatment

- Fertilising reduced the age at which trees achieved 35 cm DBH by 3-5 years

Woodhill soil results – 1985 to 2014

0-10 cm

	1985	2014
Total C (%)	Very Low	⇧
Total N (%)	Very Low	No change
Total P (mg%)	High	⇧
Bray P (mg%)	High	⇩

1985 = site value
2014 = Stem only removal no fertiliser

⇧ Significant

⇧ Not significant

Woodhill soil results – 2014

Organic matter management

Depth (cm)	Treat-ment	Bulk density (g/cm³)	Total C (%)	Total N (%)	Total P (mg%)	Bray P (mg%)
0-10	FF	a	a	a	a	a
	WT	a	b	b	a	a
	SO	a	b	ab	a	a
	DS	a	b	ab	a	a

10-20 cm and 20-30 cm No treatment effects

Woodhill soil results – 2014

Change with the addition of fertiliser

Depth (cm)	Bulk density (g/cm^3)	Total C (%)	Total N (%)	Total P (mg%)	Bray P (mg%)
0-10	none	↑	↑	↓	↓
10-20	none	↑	↑	none	↓
20-30	none	↑	↑	none	↓

Woodhill soil results – 2014

Forest floor removal treatment –
Was soil C and N recovered with fertiliser

Fertiliser amendment was unable to recover soil carbon and soil nitrogen

Woodhill soil results – 2014

Key findings were:

- FF treatment reduced soil C and N at end of rotation

- Fertiliser addition increased soil C and N, but decreased available P to depth in the soil, Total P decreased in the top 10 cm of soil only

Forest floor analysis to come – important pool of nutrients and supply of nutrients to the soil

Woodhill soil results – 2014

Future soil nutrient implications:

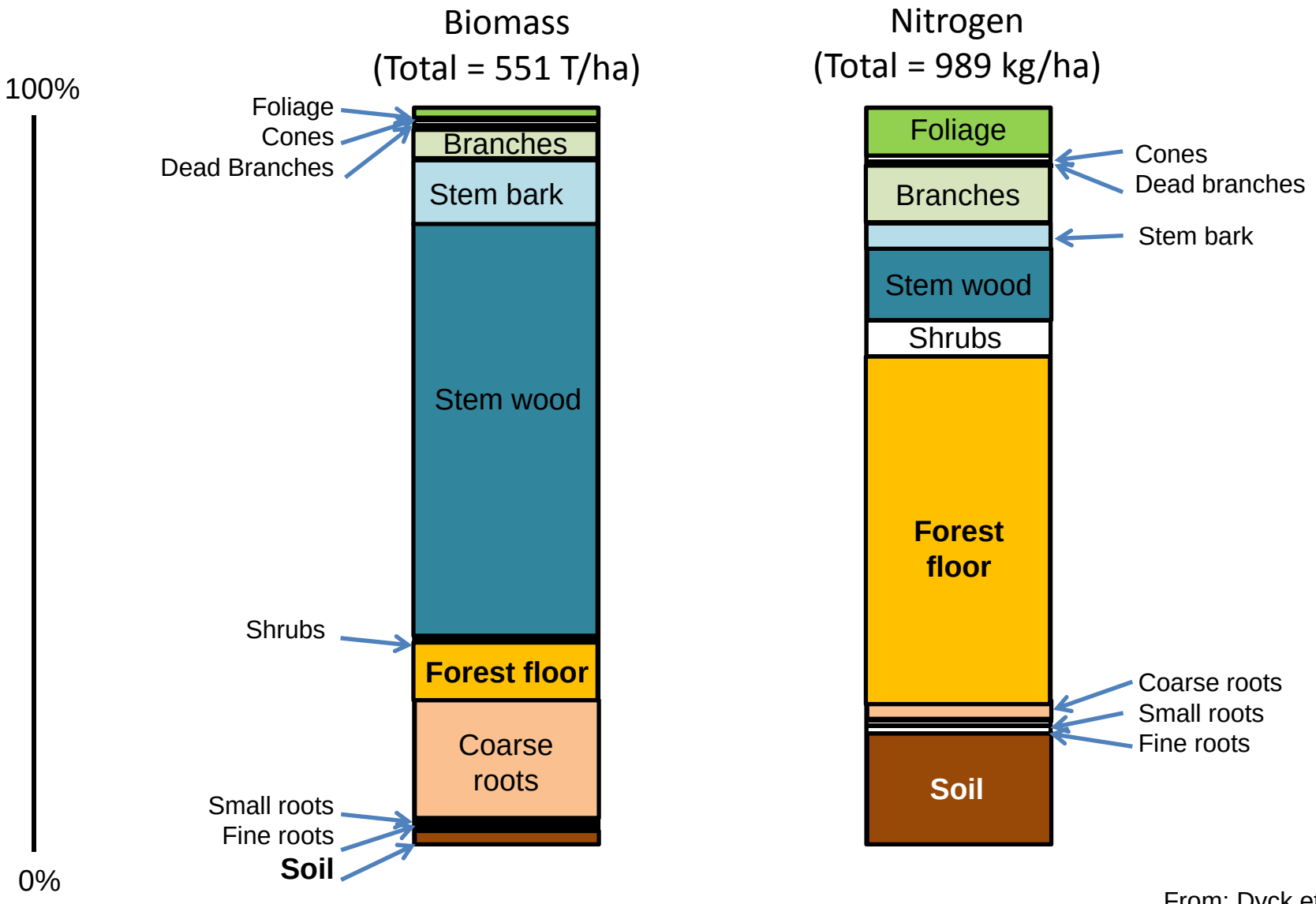
- On a sandy soil like Woodhill there is benefit in forest floor and harvest residue retention to soil C and N
- The site is N deficient even with N fertiliser application, indicating another over-riding limitation to the site
- Benefit in N fertiliser application, but need to consider impact on other nutrients – e.g. greater decrease in available P

Next up for soil and Long-term trial series

- Woodhill forest floor pool contribution to site nutrients
- Tarawera long-term trial soil and forest floor has been sampled and ready for analysis
- Using the data to test and improve NuBalM – **Nu**trient **Bal**ance **M**odel

Growing confidence in forestry's future Research Programme 2013-2019

Importance of the forest floor



From: Dyck et al. (1991).

Areas at risk

Areas planted with greater risk of N, P, Mg and B deficiencies in radiata pine

Soil order	Deficient nutrients	Area with current radiata pine (ha)	% of total radiata pine estate
Recent	N, P, B	247,015	13.5
Podzol	N, P	127,555	7.0
Pallic	B	126,230	6.9
Ultic	N, P, Mg	99,517	5.4
Raw	N, P	32,392	1.8
		632,700	**34.6**

Can forest soils supply nutrients if productivity doubled?

Current nutrient removals (kg ha^{-1})

N	P	K	Ca	Mg	
217	36.1	258	230	72	Stem only removal
421	61.8	394	417	110	Whole tree removal

Nutrient removals when productivity doubled (kg ha^{-1})

435	72.2	517	460	145.9	Stem only removal
842	123.7	788	835	220	Whole tree removal

Summary

- More than 50% of NZ's planted forest estate will soon be in its 3rd or 4th rotation, so this work provides a crucial insight into future productive potential

- Findings feed into a site specific nutrient balance model for improved nutrient management precision NuBalM – **Nu**trient **Bal**ance **M**odel

Growing confidence in forestry's future Research Programme 2013-2019

Growing confidence in forestry's future Research Programme

SCION forests · products · innovation

http://research.nzfoa.org.nz/
www.scionresearch/gcff

Loretta Garrett
loretta.garrett@scionresearch.com

25th March 2015

forestgrowers levy trust inc Funding Support Provided by the Forest Growers Levy Trust

FOREST OWNERS ASSOCIATION