CARBiFOR II

Carbon Sequestration in Irish Forest Ecosystems

International Symposium

On dynamics and ecological services of deadwood in forest ecosystems

UCD DUBLIN

Decomposition of above and belowground deadwood in managed Sitka spruce forests in Ireland

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Overview

- Introduction:
  - Irish forests
  - Sitka spruce (*Picea sitchensis* (Bong) Carr.)
- Deadwood types
- Measuring decomposition
- Some findings
- Conclusions

The Irish Forest (NFI 2007)

- 10% of the land area
- 90% is coniferous plantation
- Deadwood found in 45% of forest
  - Exceeding 5.6 million m^3
  - Decomposition of coniferous deadwood (specifically that of Sitka spruce) and its contribution to managed-forest C stocks is therefore essential for C-reporting
  - Sitka spruce forests covers 327,000 ha (52% of total forest)
  - Annual output: Over 1.4 million m^3

Methods: Coarse deadwood types

- Main sources of deadwood
  - Thinning and harvesting residues
  - Extreme climatic events (wind throws)
- Aboveground:
  - Logs (≥ 7cm minimum end diameter)
  - stumps
- Belowground:
  - Small roots (2 - 10mm)
  - Medium roots (10 – 50mm)
  - Large roots (≥ 50mm)

Method: Measuring decomposition

- Five-decay class (DC) system
  - Physical characteristics
  - Volume estimation
- Root excavation (assuming roots belong to the same DC as stump)

- Decay class density
  - Ovendry weight
  - Volume displacement

Methods: Decay dynamics

- C:N analysis
- Density decay rate (k)
  - Single exponential decay curve
    - $D_t = Do\ exp^{-kt}$
  - D_t =Density at time t
  - D_o = Density constant
  - t = time since harvest (years)

  - Half life ($t_{0.5}$ or 50% decay) = $0.693/k$

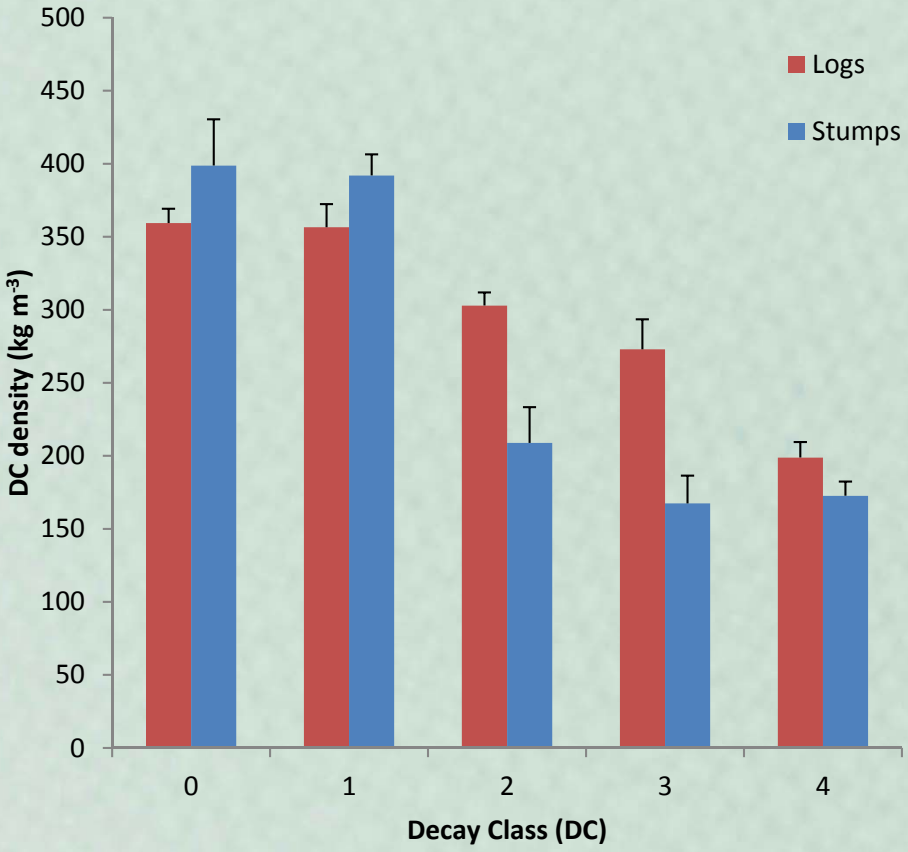
  - Residence time ($t_{0.05}$ or 95% decay) = $3/k$

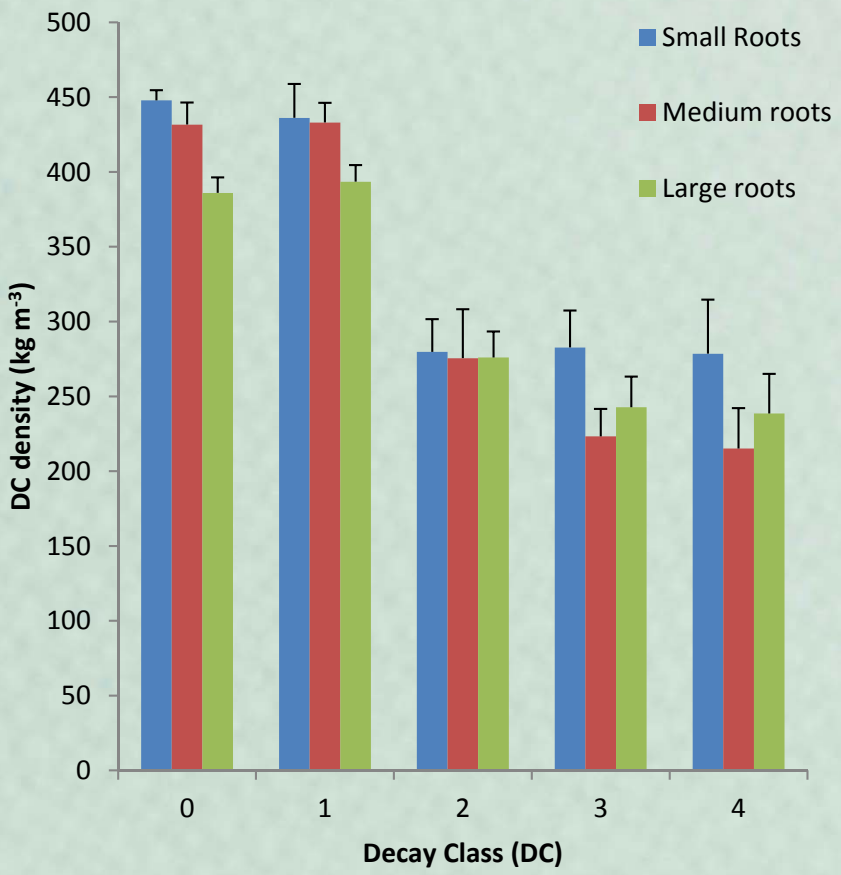
Results: C-fraction

CWD	% C-fraction	S.E	n
Logs	46.61	0.07	24
Stumps	47.47	0.09	21
Small roots	46.98	0.46	21
Medium roots	47.49	0.49	21
Large roots	47.89	0.37	21
All CWD	47.26	0.15	108

- No differences across DCs (ranged from 46 - 48%)
- Tobin *et al.*, (2007)

Results: Density loss

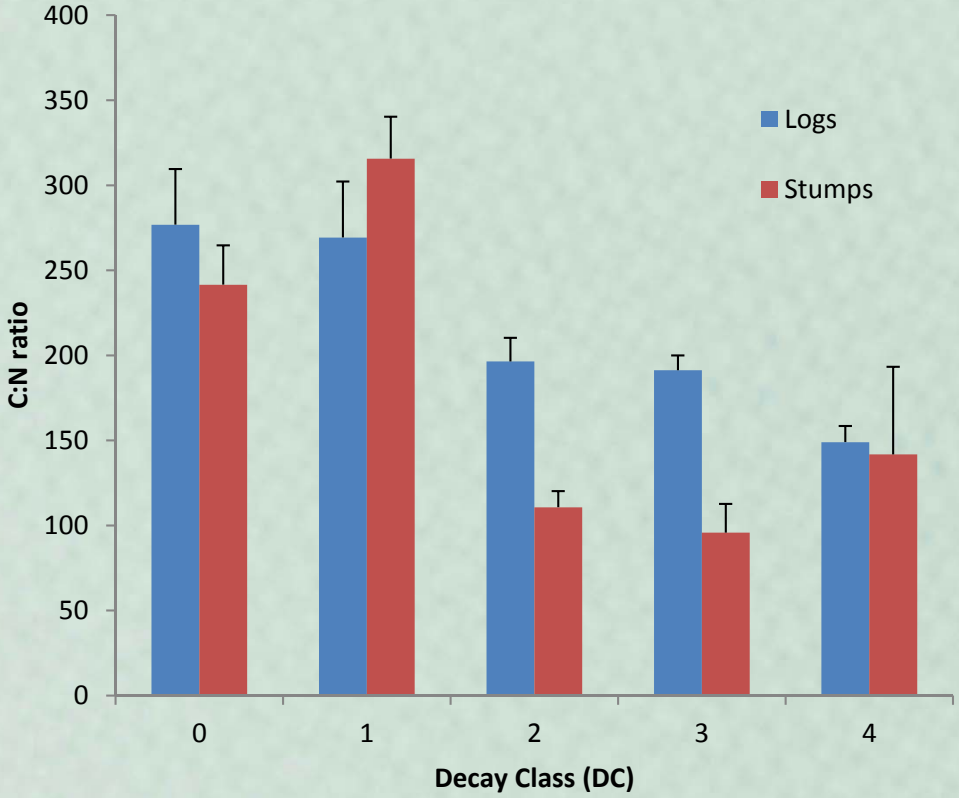


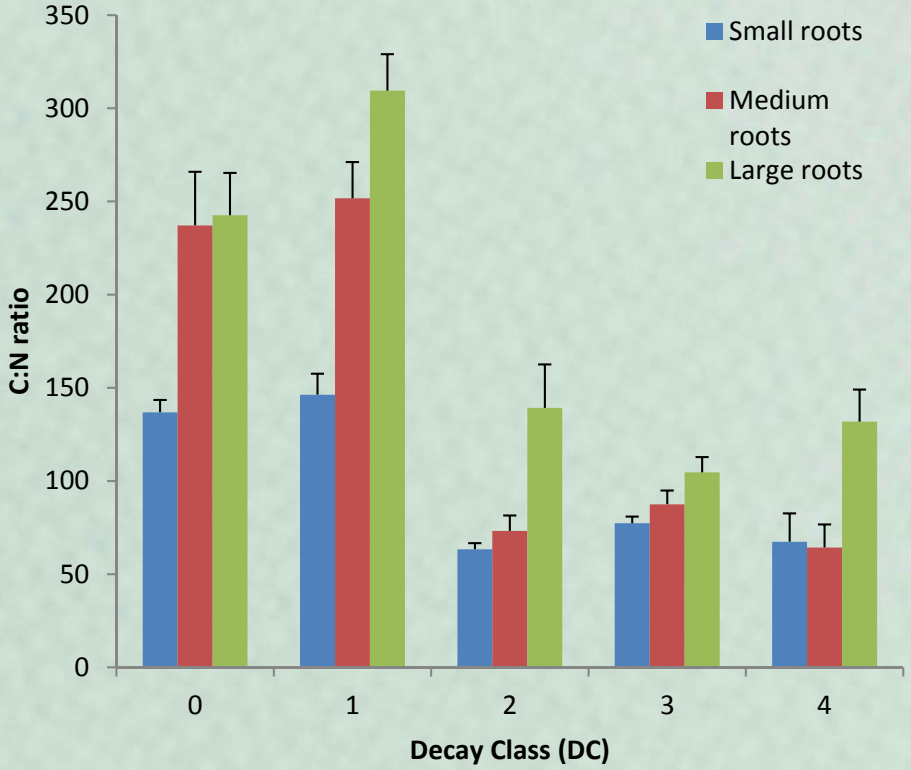


Density decrease in Logs (45%) and Stumps (58%)

Density decrease in small roots (38%), medium roots (50%) large roots (38%)

Results: C:N ratio

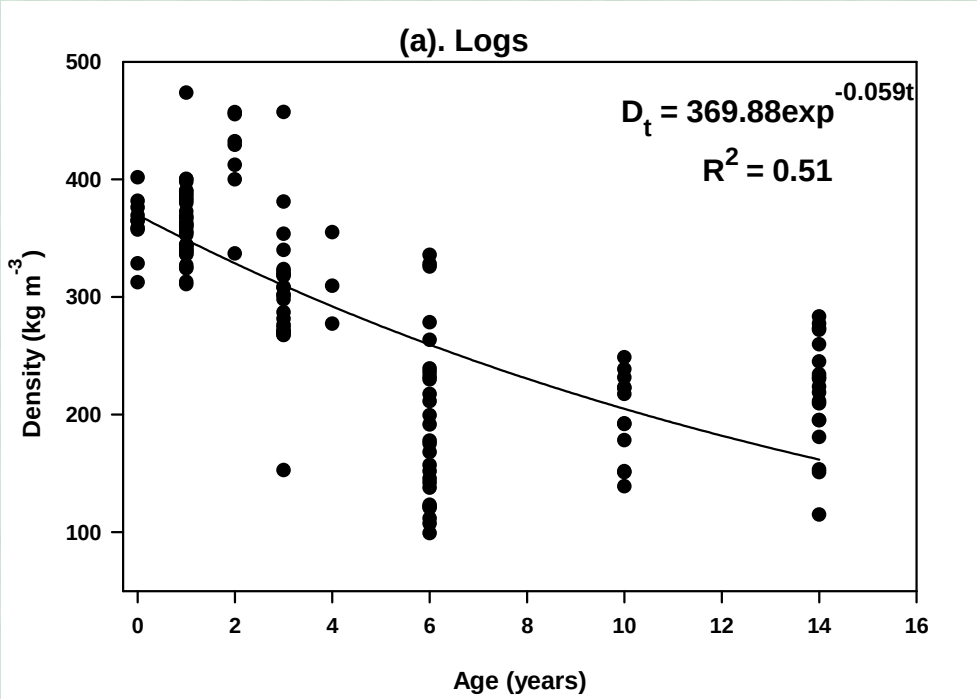


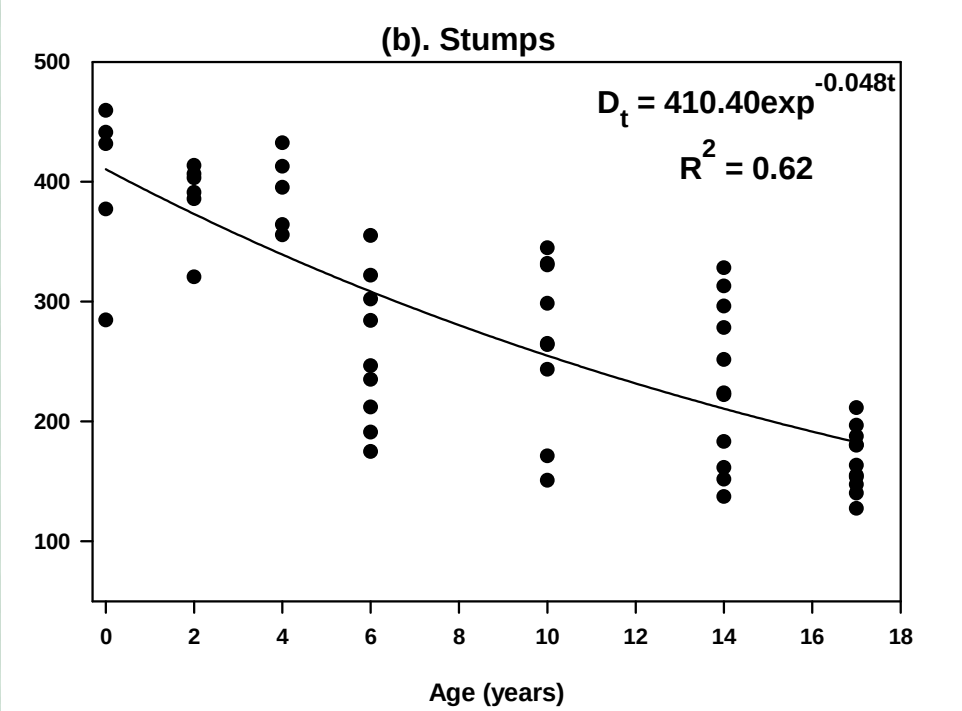


C:N ratio decreased with increased decay in logs (46%), stumps (41%)

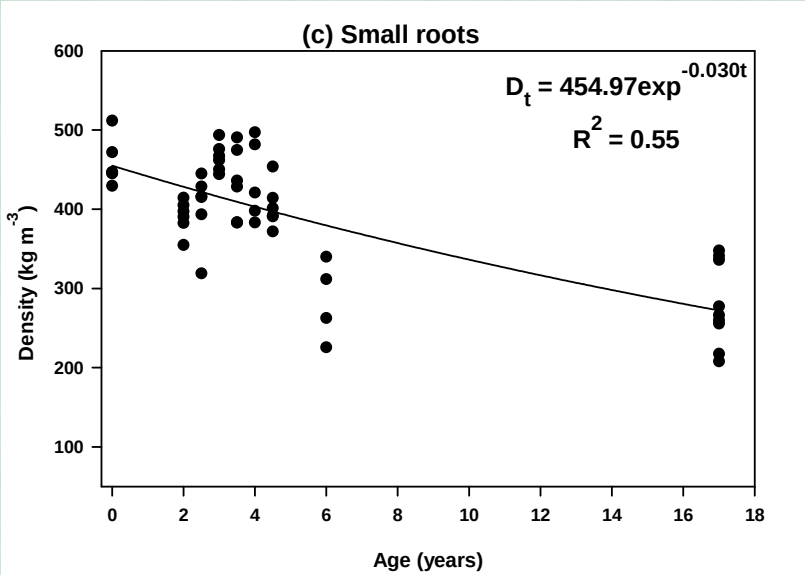
C:N ratio decreased with increased decay in small roots (51%), medium roots (72%), large roots (57%)

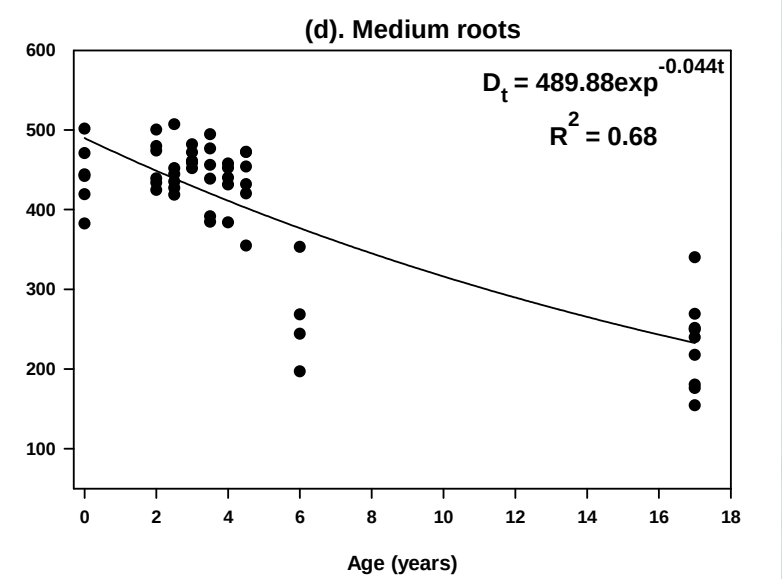
Decay Curves : Logs and Stumps

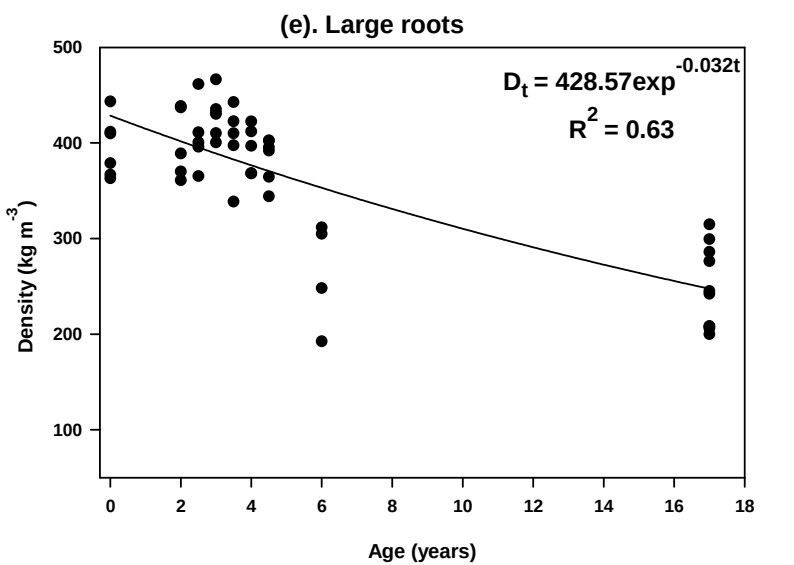




Decay curves: Roots







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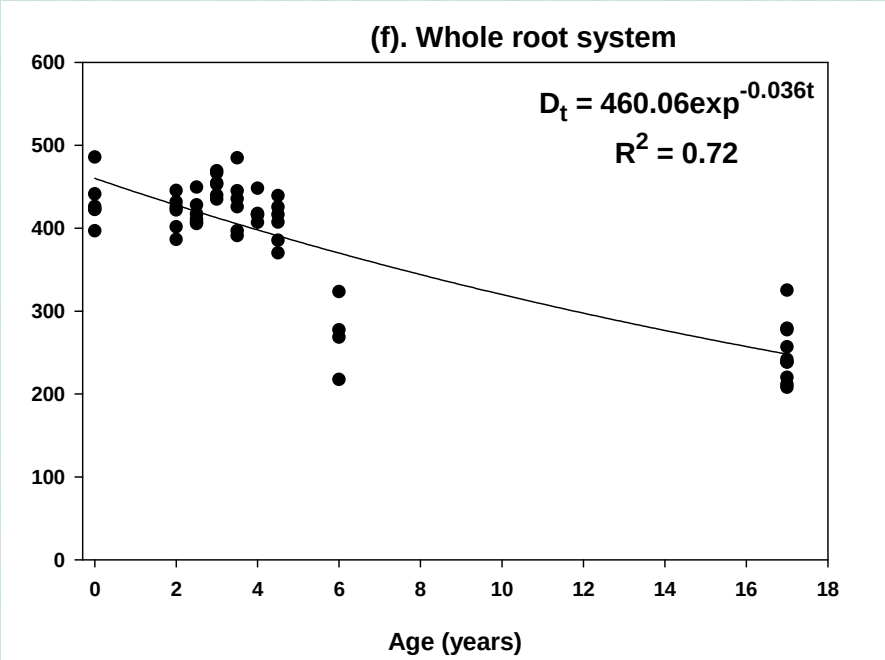
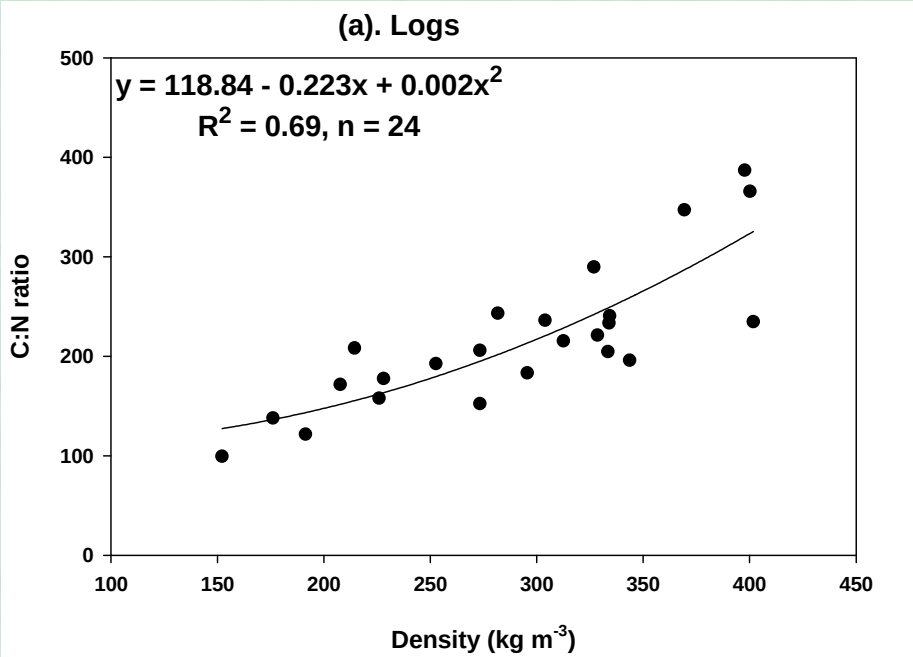
Decay curves : Whole root system

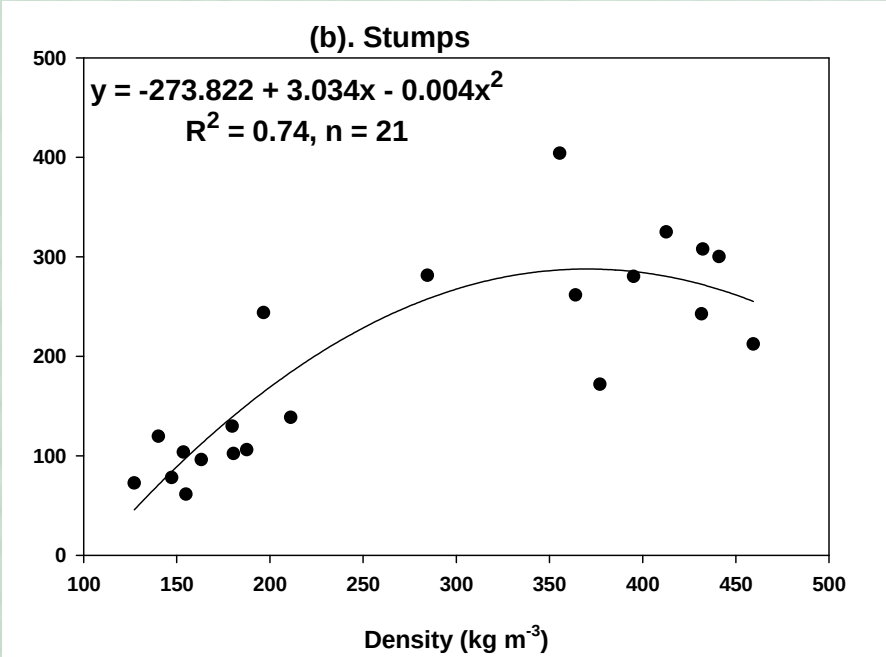


Deadwood	*k* (kg m^{-3} year^{-1})	S.E.	n	$t_{0.5}$ (years)	$t_{0.05}$ (years)
Logs	0.059	*0.005*	143	12	51
Stumps	0.048	*0.005*	56	14	62
Small roots	0.030	*0.004*	54	23	99
Medium roots	0.044	*0.005*	54	16	68
Large roots	0.032	*0.004*	52	22	94
All roots	0.036	0.003	54	19	83

- Belowground decays slower than aboveground
- Medium roots had the lowest decay rate
- Residence time maybe be an overestimation

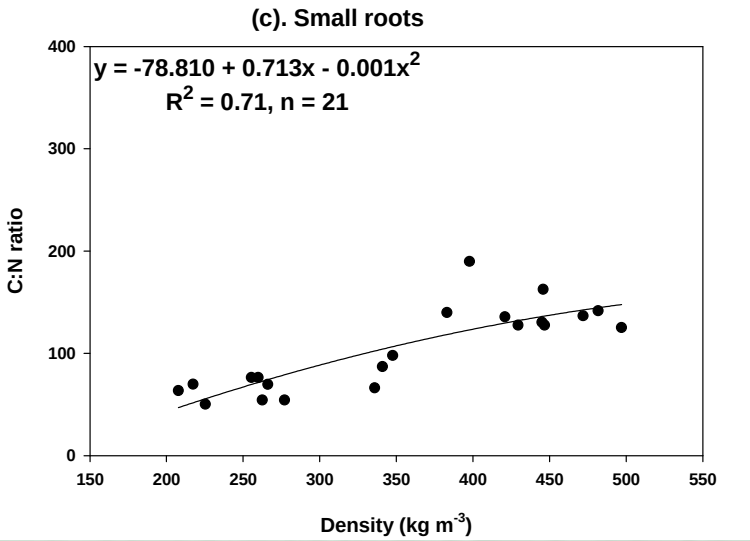
Density and C:N interaction: Logs and Stumps

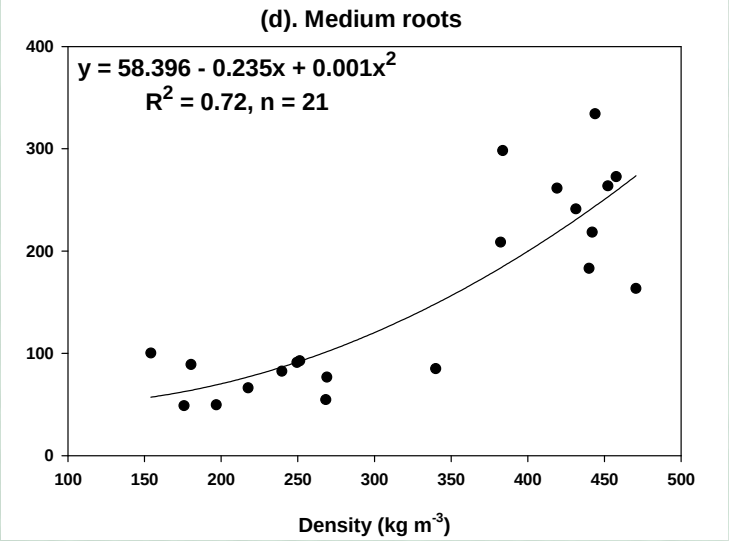


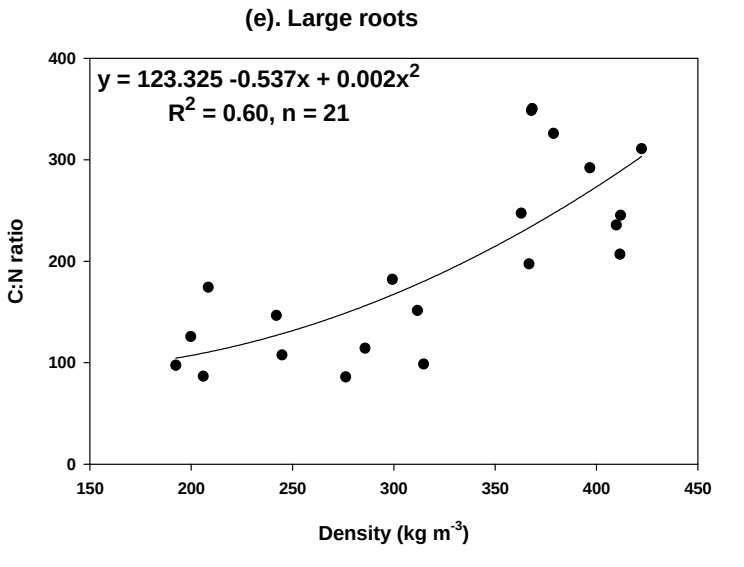


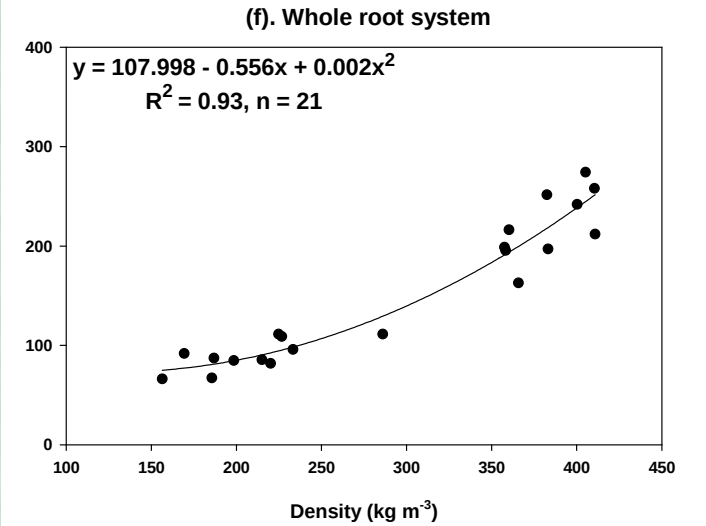
- Density was positively correlated with C:N ratio

Density and C:N interaction: Roots









Conclusions

- Aboveground decayed faster than belowground
- Density and C:N ratio are positively correlated in deadwood
- IPCC 10-year decay period may be an underestimation
- 87% of Irish forest still in the juvenile stage (unthinned)
- Deadwood will become increasing important as these forests are thinned in the future

Acknowledgements







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Thanks for listening

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