

# Potential C sequestration through forestry on erosion-prone land in New Zealand

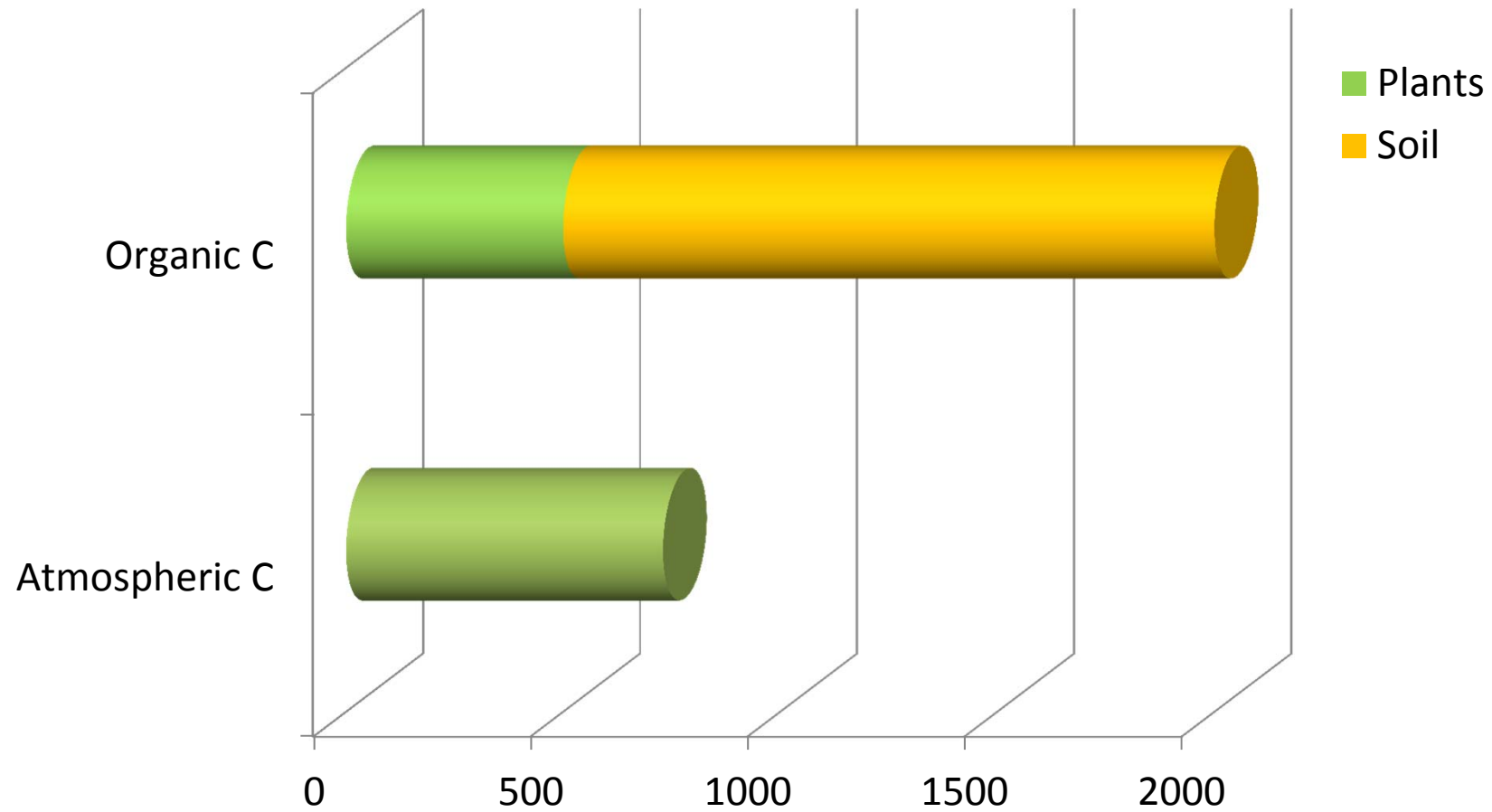
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# Outline

- Summary of proposal
- Uncertainty of sequestration rates
- Species choice
- Wildings
- Long term consequences of “plant and leave”

# Carbon contents (Pg)

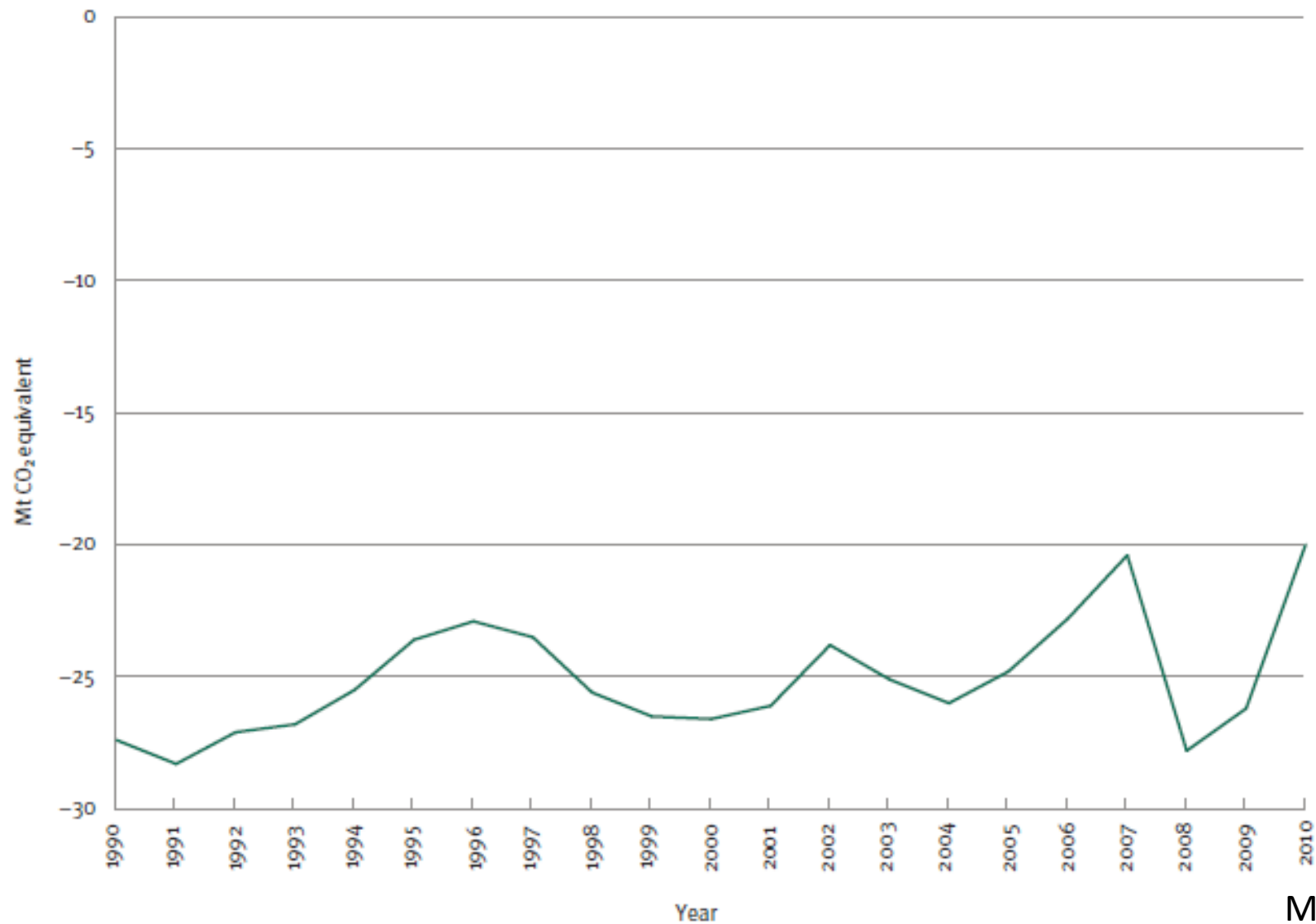


Forests are carbon reservoirs



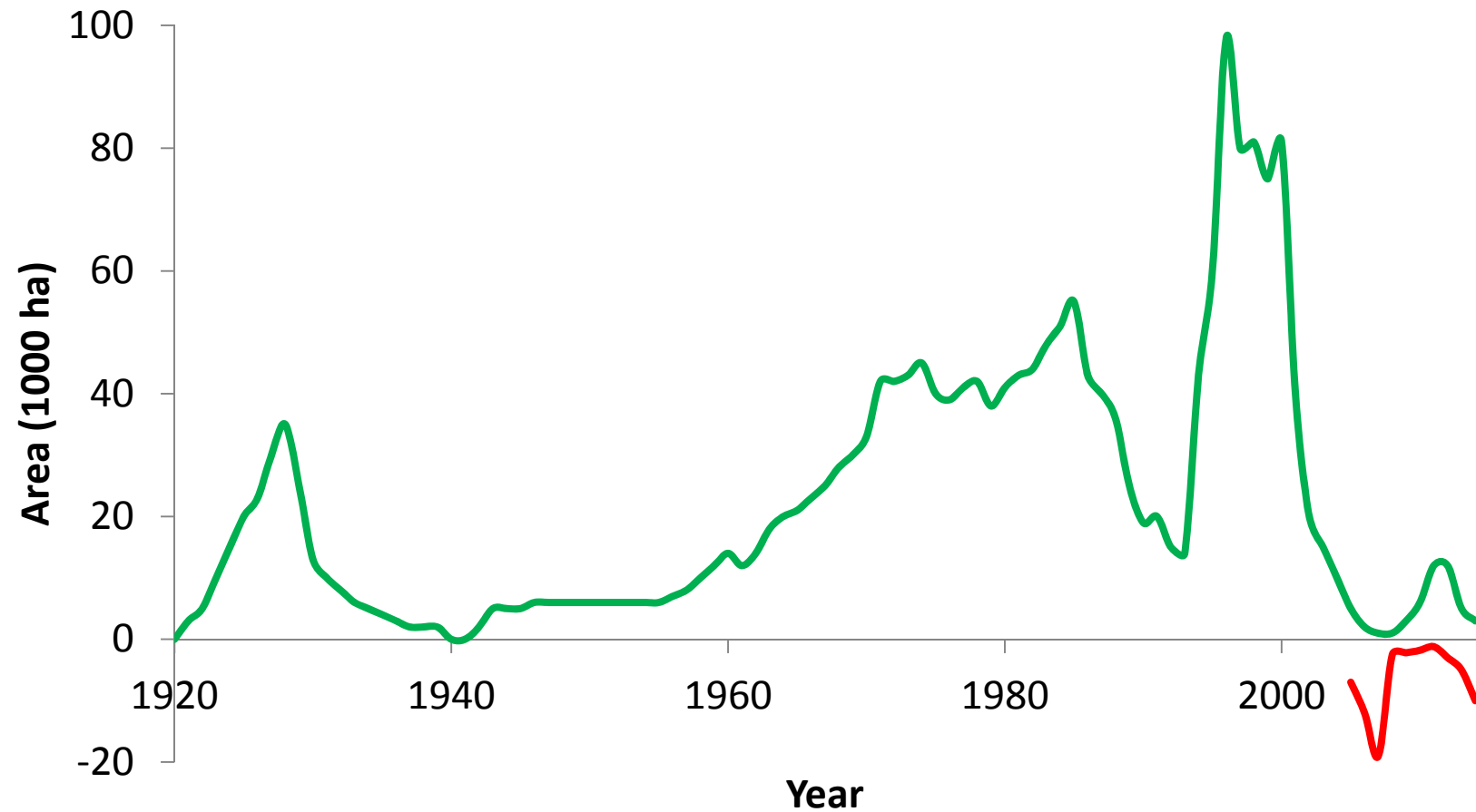
New forests are carbon sinks

# GHG removals by NZ forestry



MfE (2012)

# Exotic species planted or deforested



### Erosion Risk Susceptibility

- High
- Moderate
- Low
- Undefined



Note: Version 5, 13 May 2011  
Produced by Justin Morgenroth

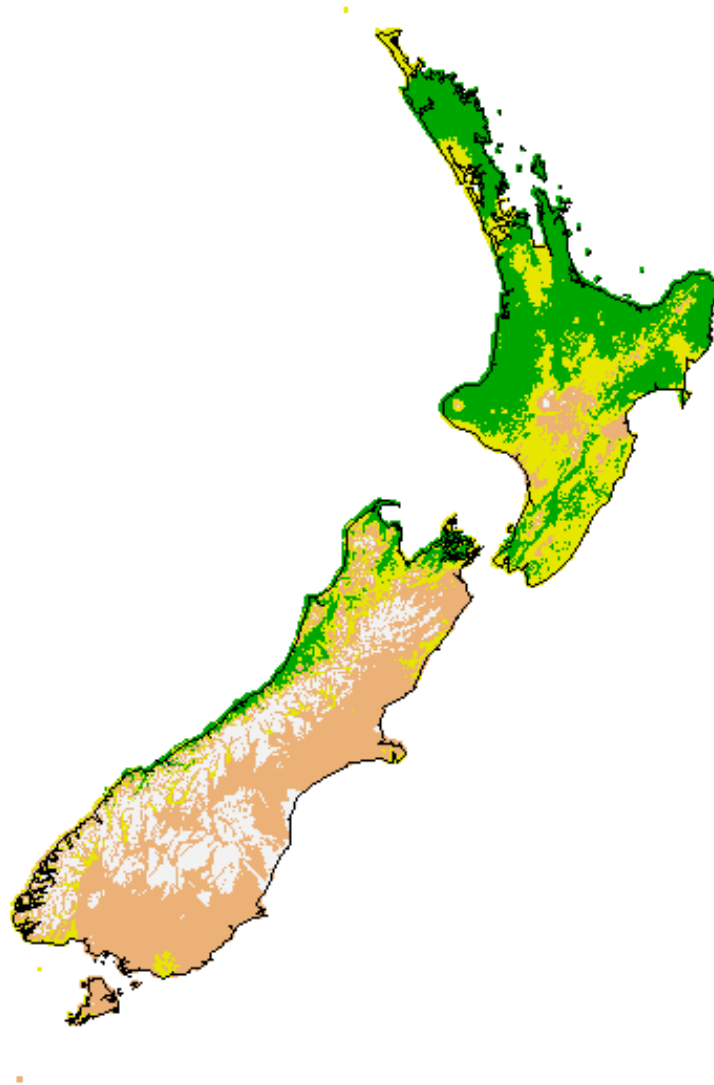
0 50 100 200 300 400 Kilometers







# Land available – productivity classes



# Current cover for “compliant” land

- ✓ Gorse and/or broom
- ✓ High producing exotic grassland
- ✓ Low producing exotic grassland
- ✓ Short-rotation cropland
- ✓ Landslides

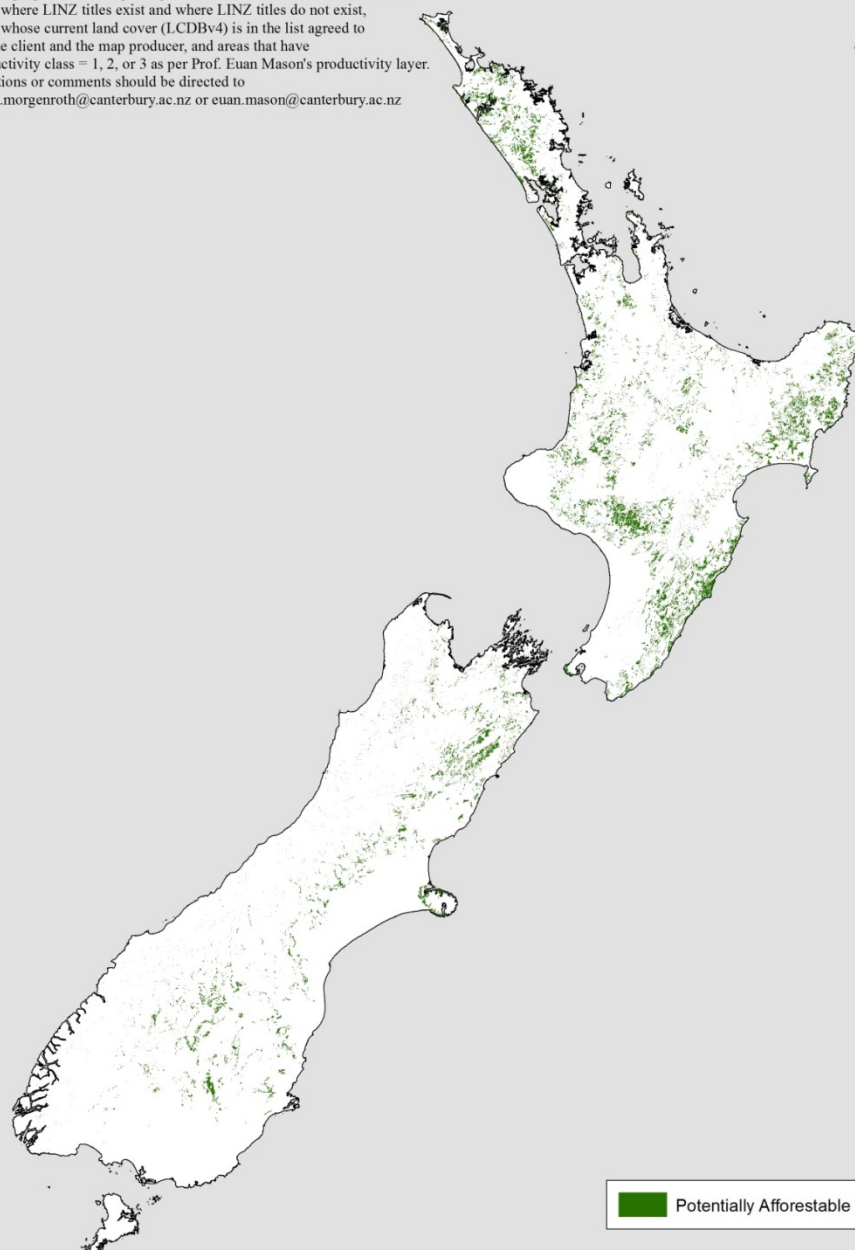
# Threatened environment classes

Threatened Class	Description
0	No Data
1	Acutely Threatened
2	Chronically Threatened
3	At Risk
4	Critically Underprotected
5	Underprotected
6	Less Reduced and Better Protected


# Erosion-prone, compliant land in NZ (hectares)

Threatened environment class	-----Productivity class-----			TOTAL
	Low <a href="#">[1]</a>	Medium	High	
<b>0</b>	89	39	27	<b>155</b>
<b>1</b>	51457	112189	34435	<b>198081</b>
<b>2</b>	34545	97540	129380	<b>261465</b>
<b>3</b>	22914	59242	98758	<b>180914</b>
<b>4</b>	87952	38753	72864	<b>199569</b>
<b>5</b>	38508	9429	38038	<b>85975</b>
<b>6</b>	131892	65396	188505	<b>385793</b>
<b>TOTAL</b>	<b>367357</b>	<b>382588</b>	<b>562007</b>	<b>1311952</b>

This map is not meant for publication or distribution.  
It is only to be used as a rough guide to show the location of the approximately 1.31 million hectares of land that could be afforested.  
For the purpose of this reporting, land that could be afforested includes areas where LINZ titles exist and where LINZ titles do not exist, areas whose current land cover (LCDBv4) is in the list agreed to by the client and the map producer, and areas that have productivity class = 1, 2, or 3 as per Prof. Euan Mason's productivity layer. Questions or comments should be directed to [justin.morgenroth@canterbury.ac.nz](mailto:justin.morgenroth@canterbury.ac.nz) or [euan.mason@canterbury.ac.nz](mailto:euan.mason@canterbury.ac.nz)



 Potentially Afforestable Land

0 50 100 200 Kilometers  


# Sequestration options

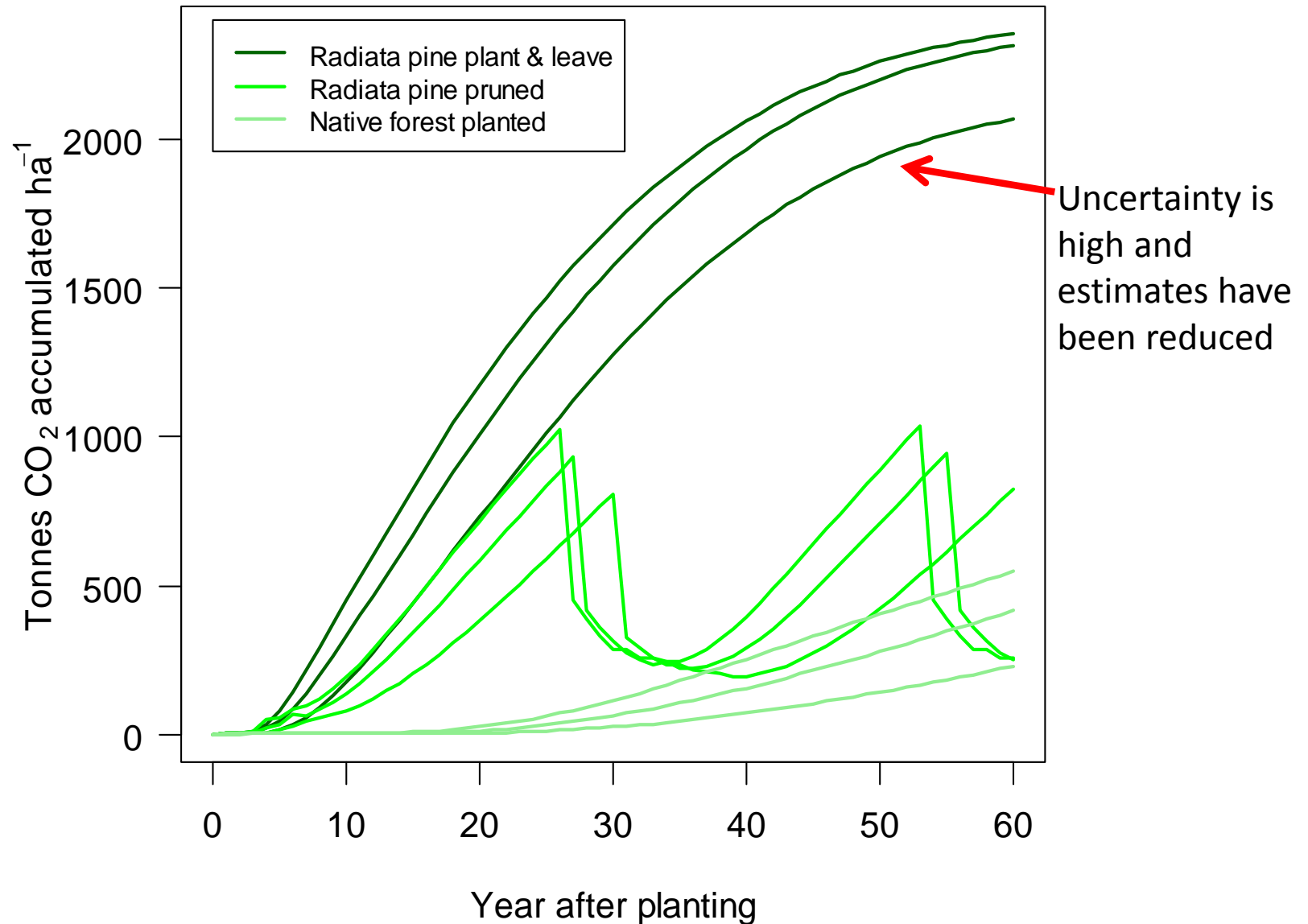
- 1) Plant and leave the entire area in radiata pine at a planting rate of 50,000 ha/year over 26 years
- 2) Plant at the same rate but prune, thin and harvest all of it at an appropriate time then replant
- 3) A 50:50 mixture 1 and 2
- 4) Plant the total area in native forest at 50,000 ha/year
- 5) A 50:50 mixture of 1 and 4 with 1 confined to the 3 least threatened environments
- 6) A 50:50 mixture of 3 and 4 with 3 confined to the 3 least threatened environments



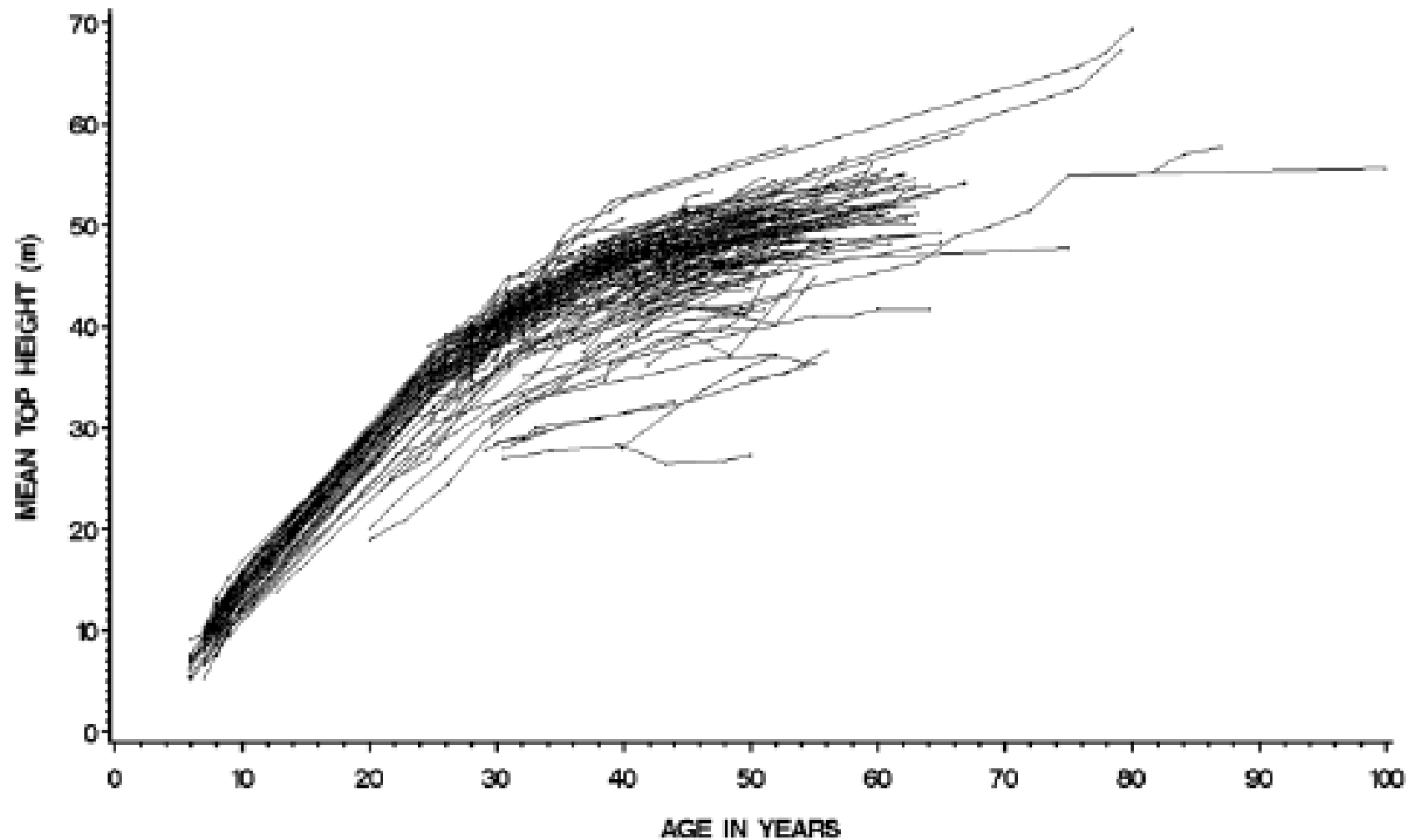
# Simulations

- Forecaster software
- 300 Index model for radiata pine
- C\_CHANGE model to estimate C content
- Native forest
  - 3.8 to 9.1 tonnes of CO<sub>2</sub>/ha/year
  - Similar stand development pattern to radiata pine

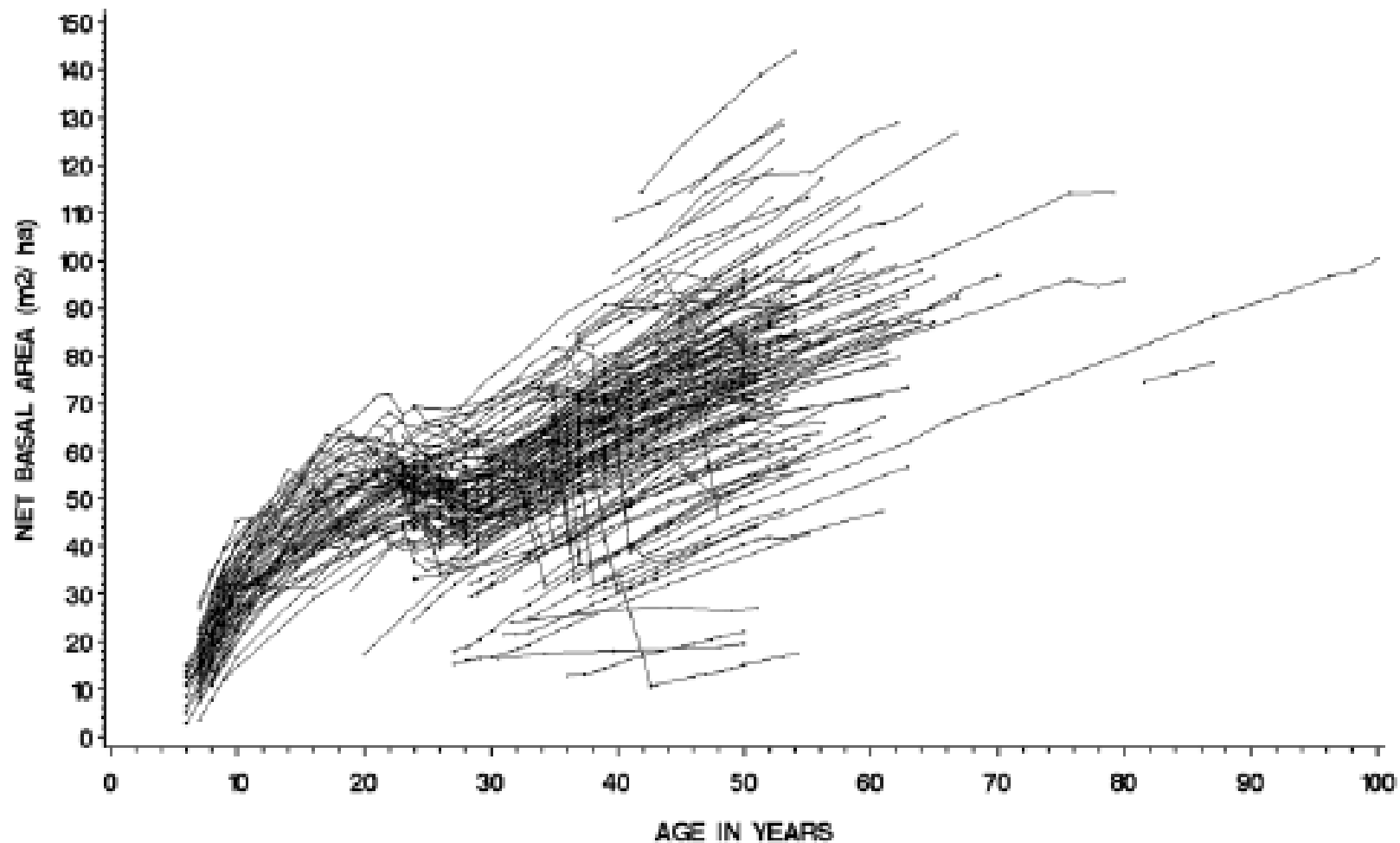
# Sequestration profiles



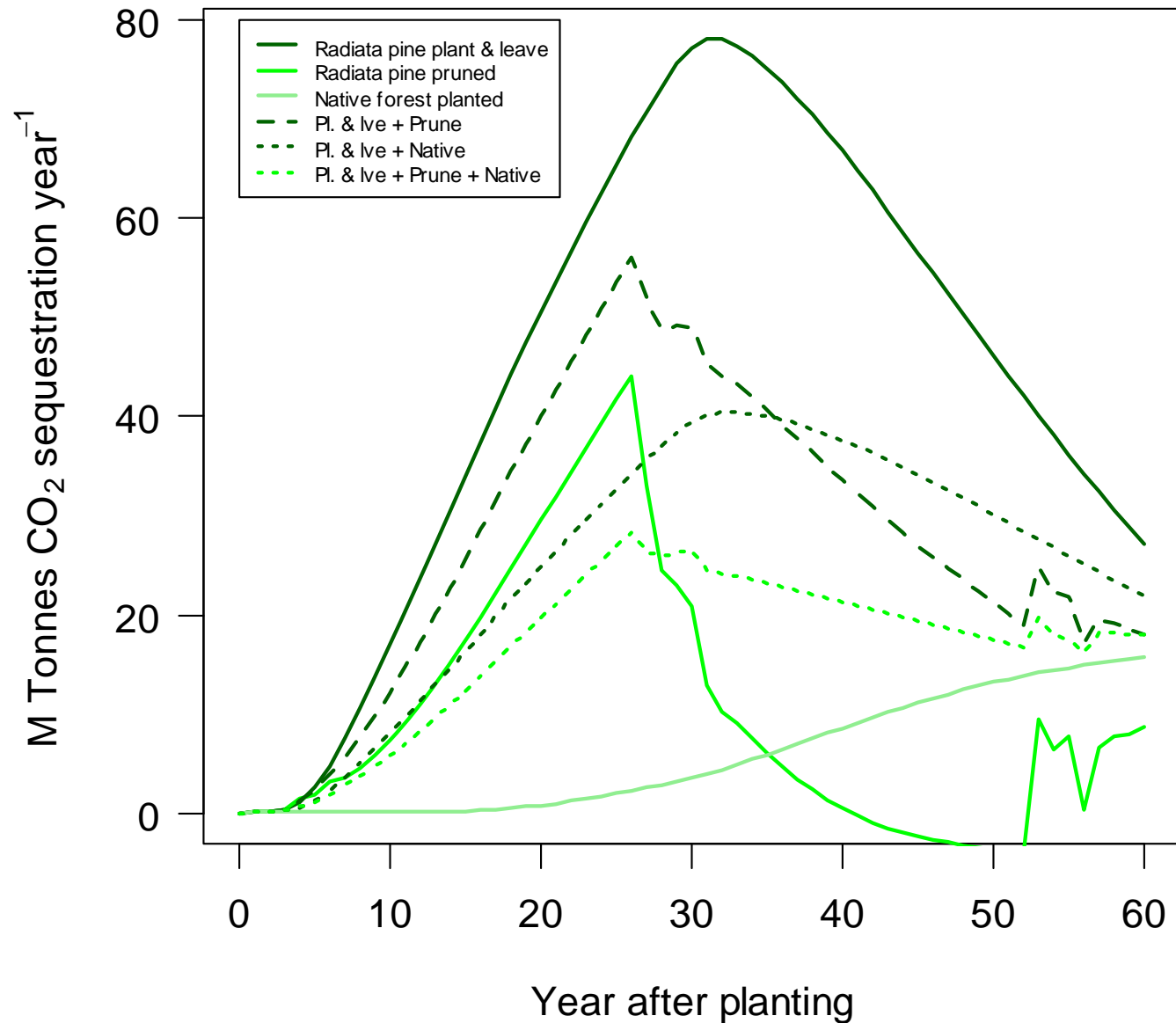
# “Plant and leave” option data



# “Plant and leave” option data



# Establishment options and C sequestration



# Species choice

- In practice, with appropriate policies landowners would establish a variety of species
- Radiata pine unjustifiably has a bad reputation
  - It does not “sour the soil”
  - It does not produce a “biological desert”
  - It poses a very low wilding risk compared to many other exotic species

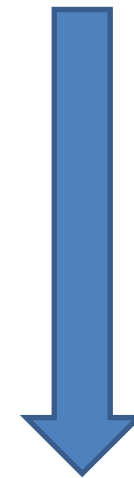


# Why consider radiata pine?

- Rapid growth and high C sequestration rate
- We are experts at producing cheap seedlings for this species
- Grows on a wide range of sites
- Studies suggest that radiata pine will continue to sequester carbon for up to 100 years on some sites
  - We assumed 60 in our analysis.
- On warm, moist sites it would act as a nurse crop for native forest
- It is not a high country wilding risk.

# Wildings

- Species
  - Radiata pine, Muricata pine
  - Ponderosa pine
  - Larch
  - Lodgepole pine and Douglas fir
  - Scots pine and Corsican pine
- “Take off site”
- Low intensity down-wind management



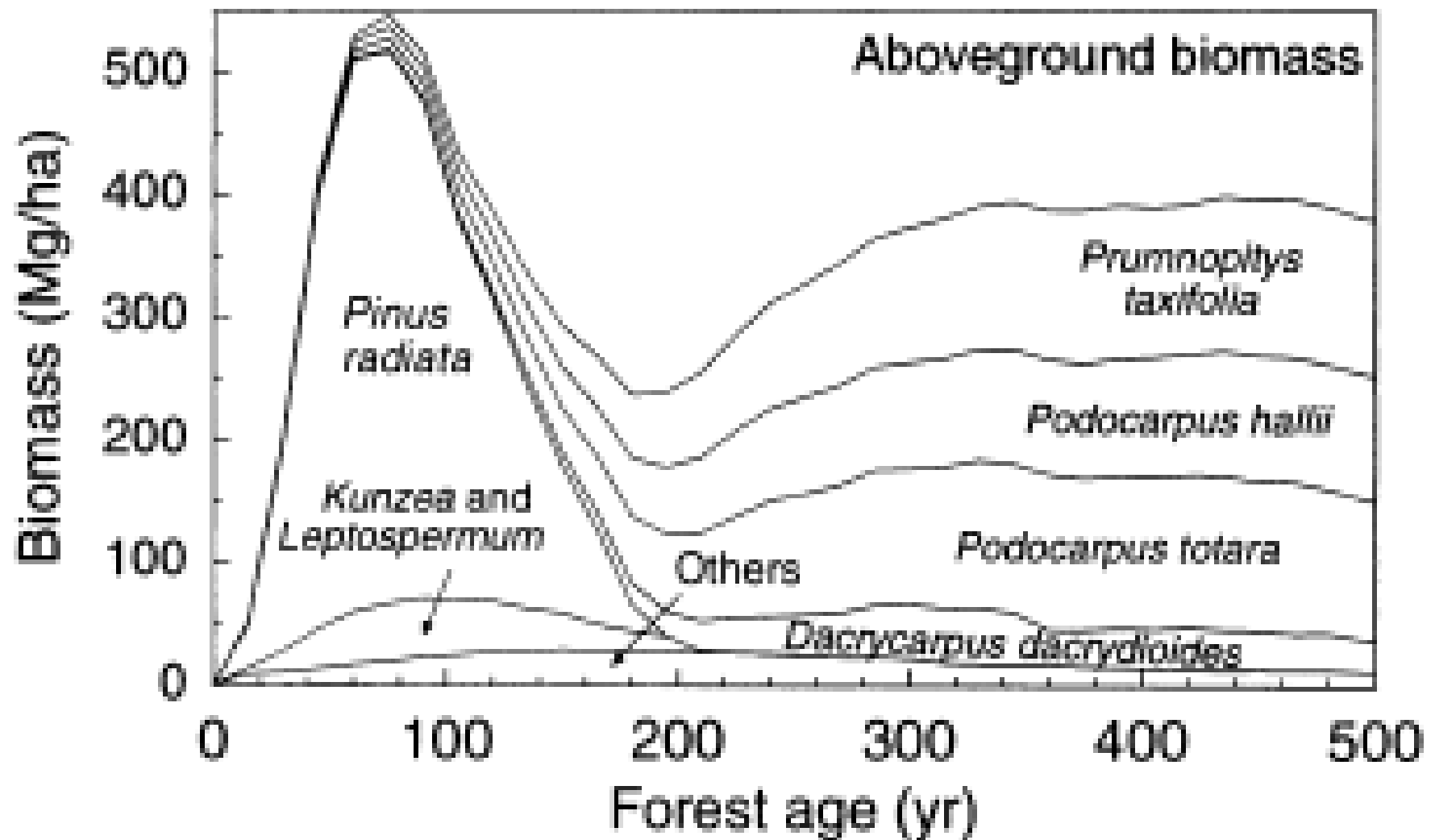
Increasing  
Risk

Source: Nick Ledgard

# Long-term consequences of “plant and leave”

- Ecological succession to native forest on some sites
  - Radiata pine = shade-intolerant pioneer
- Plenty of indigenous biodiversity in plantations
  - Allen *et al.* (1995), Norton (1998)
- Indigenous biodiversity in exotic plantations increases with
  - Warm and wet sites (naturally high diversity)
  - Stand age
  - Proximity of seed sources

Forbes (2015)



Hall, G. M. J. (2001). Mitigating an organisation's future net carbon emissions by native forest restoration. *Ecological Applications*, 11(6), 1622-1633.

# Summary

- Forests can store an enormous amount of C, relative to the amount in the atmosphere
- New Zealand has 1.3 M ha of “compliant”, erosion-prone land
- Afforesting this land would enable us to meet our international GHG mitigation commitments
  - Several options available

# Summary

- A variety of species could be used
- Erosion-prone land is a logical place to plant
  - Benefit of erosion control
  - Options for high country farmers to profit
- Species choice optional
  - Radiata pine used as an example (for sound reasons, eg: wildings not an issue)
- Long-term consequence: indigenous forest on some land