



Manaaki Whenua  
Landcare Research

# Afforestation and water yield: the New Zealand experience

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# Overview

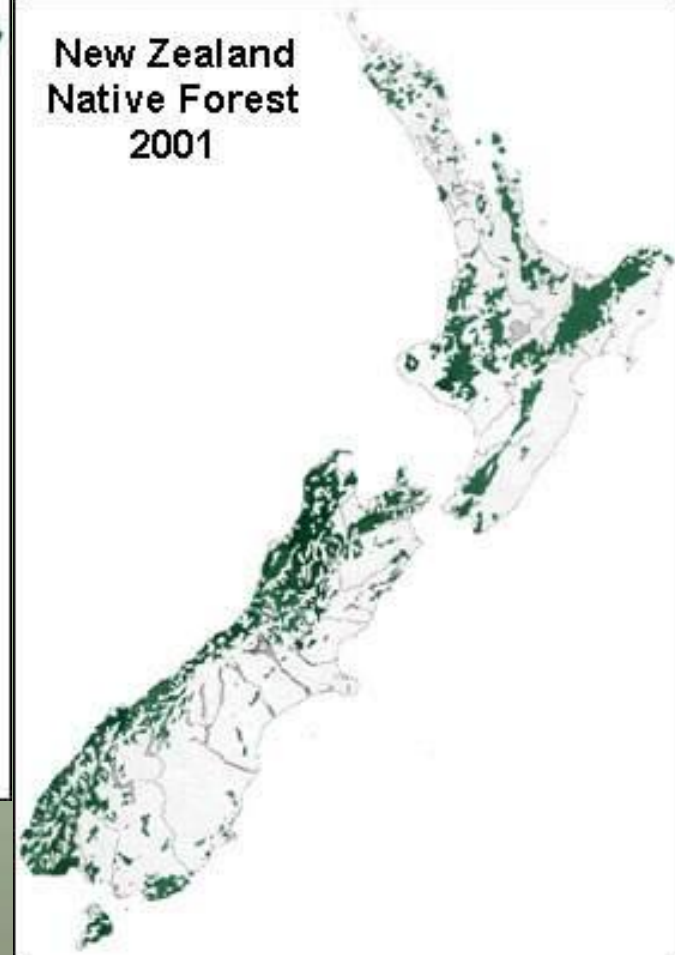
New Zealand  
Native Forest  
1000 AD



New Zealand  
Native Forest  
1840



New Zealand  
Native Forest  
2001

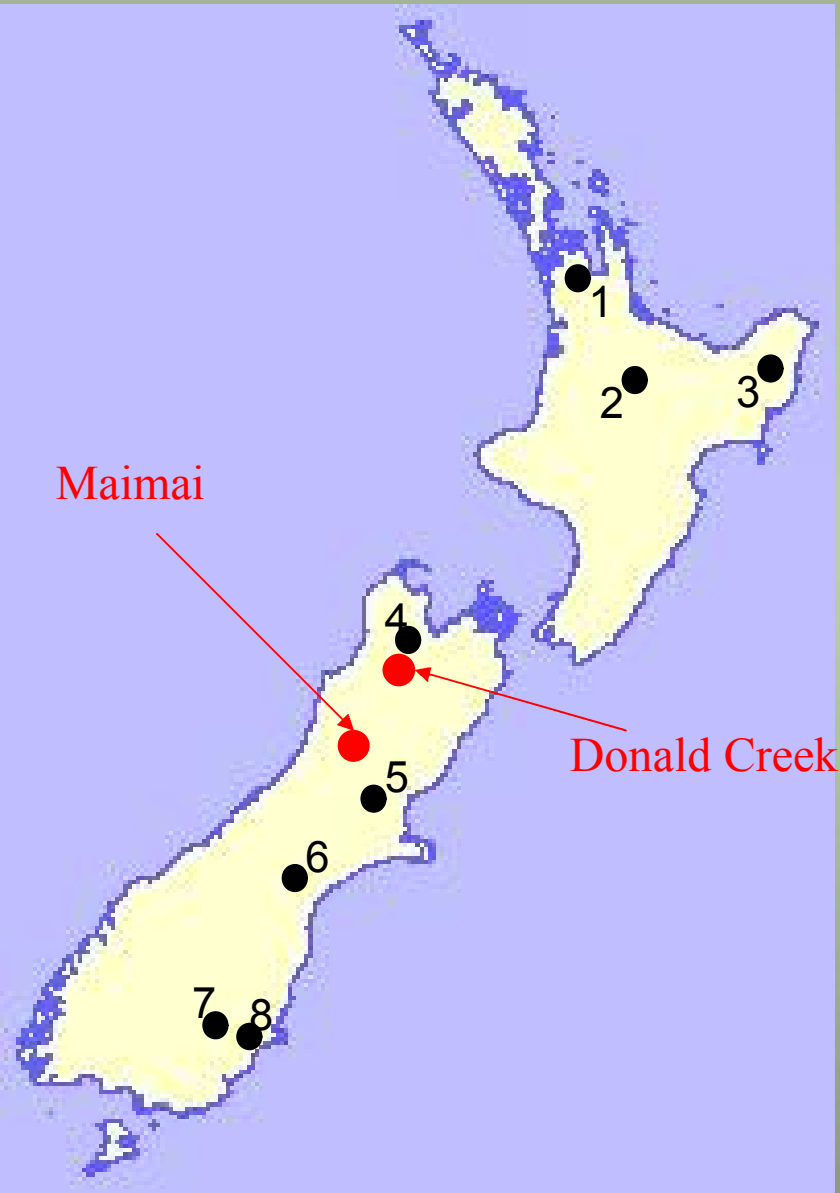


# Plantation forestry

- Mostly *Pinus radiata*
- 2002 – 1.8 million hectares (7% land area)



# Afforestation catchment studies



1 - Moumoukai

2 - Purukohokohu

3 - Mangatu

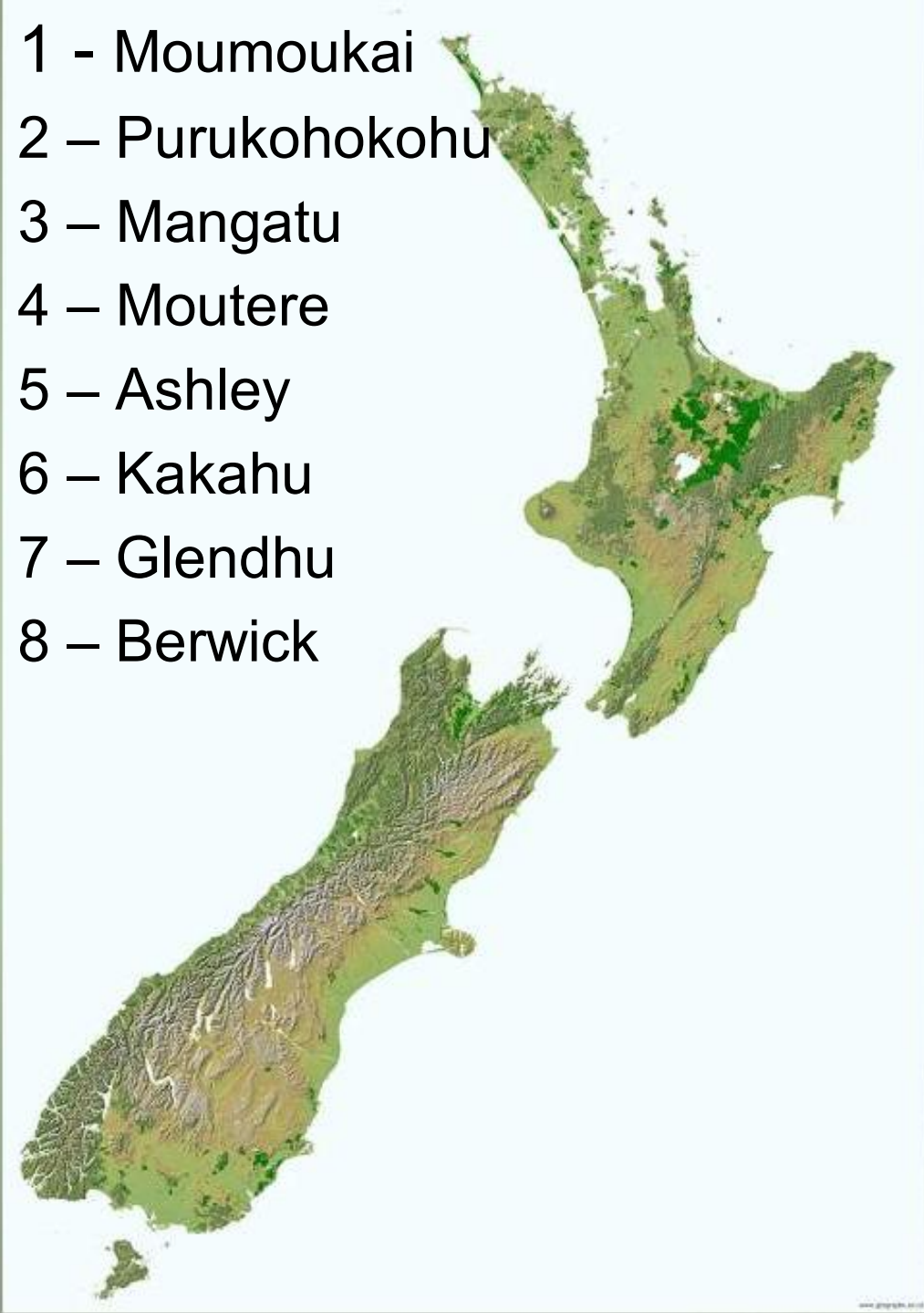
4 - Moutere

5 - Ashley

6 - Kakahu

7 - Glendhu

8 - Berwick



# Brief summary of results

| <i>Catchment</i> | <i>Land use change</i> | <i><math>\Delta</math> total water yield</i> |
|------------------|------------------------|----------------------------------------------|
| Mangatu          | Pasture to pine forest | - 30%                                        |
| Porukohukohu     | Pasture to pine forest | - 30%                                        |
| Berwick          | Pasture to pine forest | - 45%                                        |
| Moutere          | Pasture to pine forest | - 80%                                        |

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| Moutere          | Pasture to pine forest | - 80%                      |
| Glendhu          | Tussock to pine forest | - 30% **                   |
| Moumoukai        | “Scrub” to pine forest | - 37%                      |
| Moutere          | Gorse to pine forest   | 0 – 45%                    |

# Brief summary of results

| <i>Catchment</i> | <i>Land use change</i>                          | <i>Δ total water yield</i> |
|------------------|-------------------------------------------------|----------------------------|
| Mangatu          | Pasture to pine forest                          | - 30%                      |
| Porukohukohu     | Pasture to pine forest                          | - 30%                      |
| Berwick          | Pasture to pine forest                          | - 38%                      |
| Moutere          | Pasture to pine forest                          | - 80%                      |
| Glendhu          | Tussock to pine forest                          | - 30% **                   |
| Moumoukai        | “Scrub” to pine forest                          | - 37%                      |
| Moutere          | Gorse to pine forest                            | 0 – 45%                    |
| Tarawera         | Large scale afforestation<br>(28% of catchment) | - 13%                      |



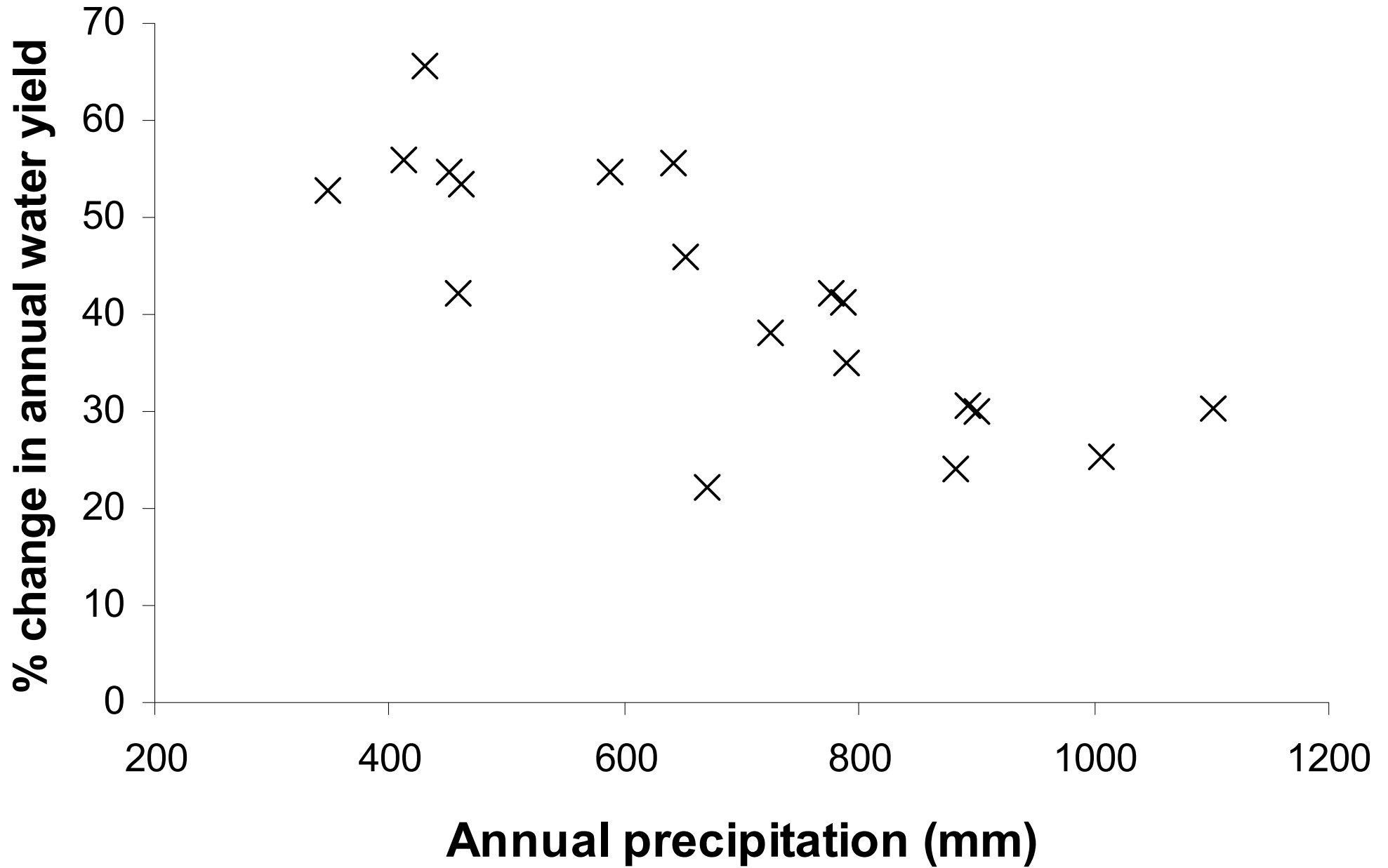


# Annual water yield summary

- 30-80% reduction following afforestation from pasture
- 37% reduction following afforestation of scrub
- Similar for gorse
- Percentages can be deceptive
  - 10% of total rainfall may or may not be important
- Normally long term averages
  - Variation year to year





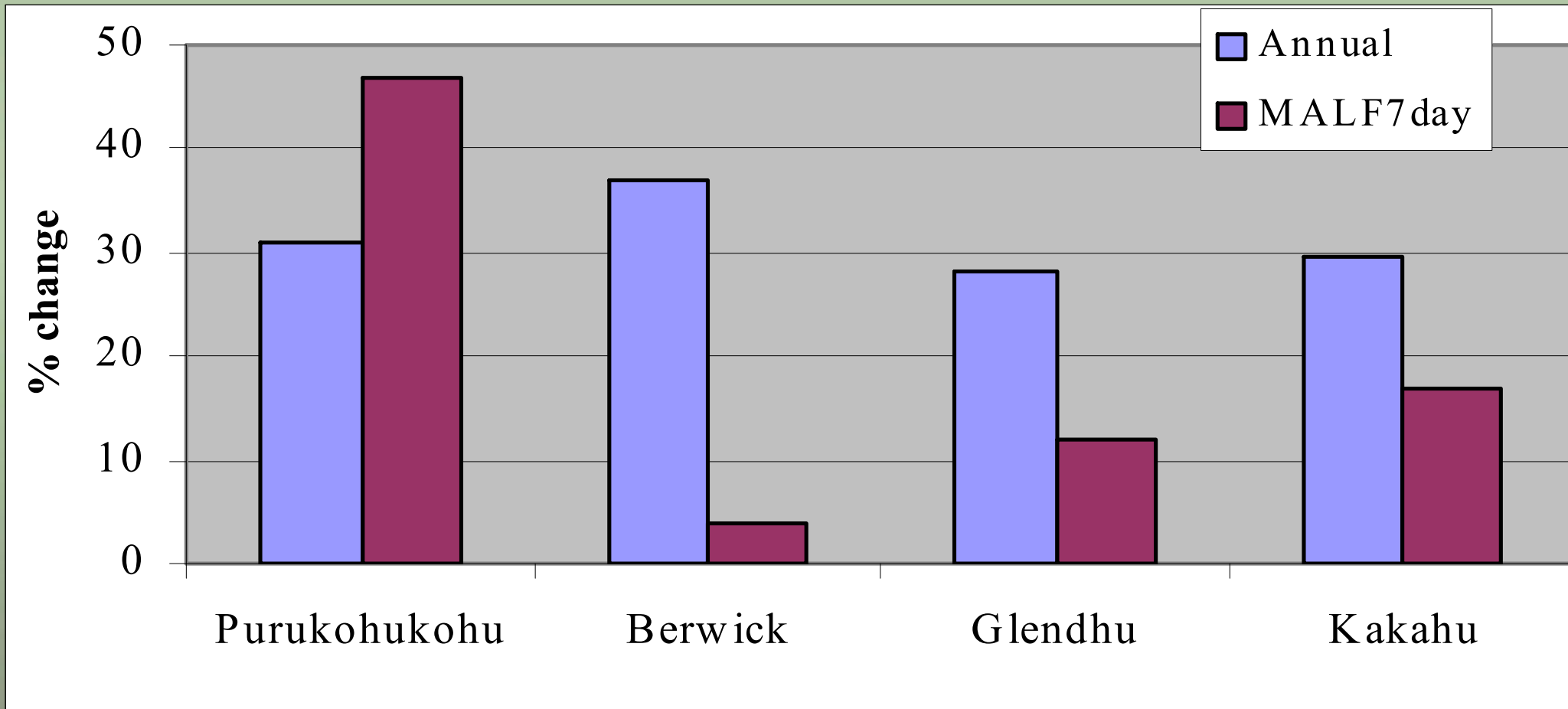


# Annual water yield summary

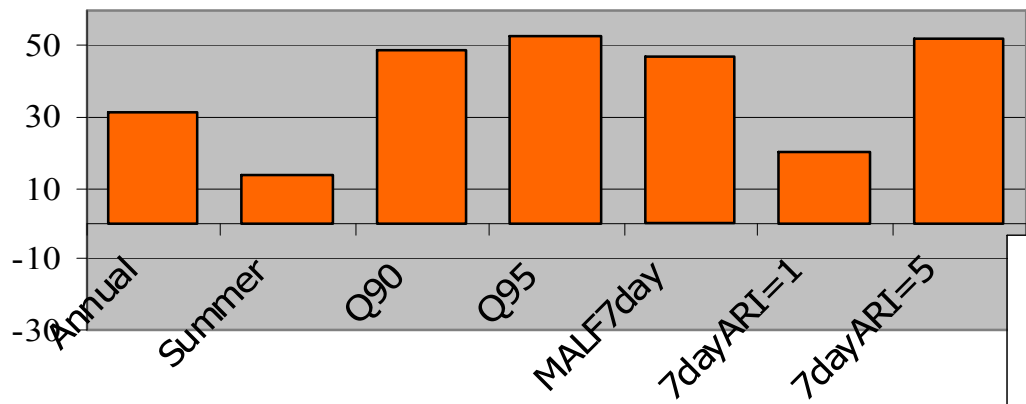
- 30-60% reduction following afforestation from pasture
- 37% reduction following afforestation of scrub
- Similar for gorse
- Percentages can be deceptive
  - 10% of total rainfall may or may not be important
- Normally long term averages
  - Variation year to year
  - Timing of average important
    - Ashley drops from 62% to 52% by including one more year's data

# Annual yield vs low flows

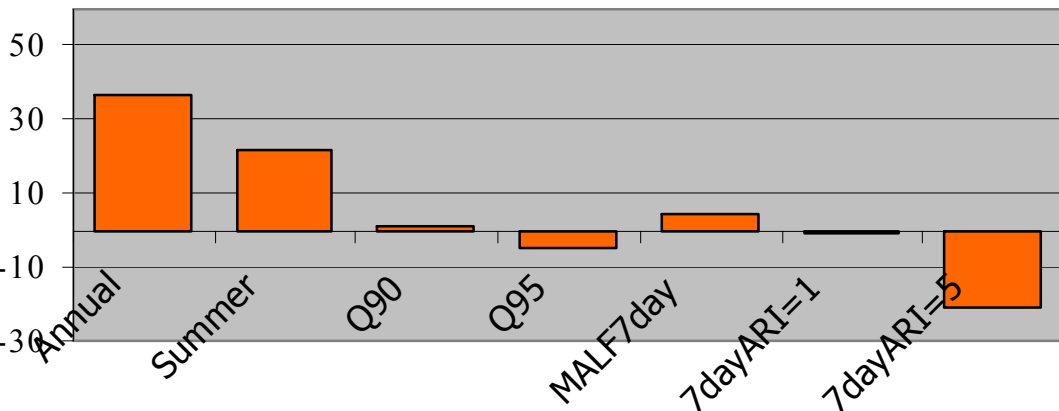
## Annual yield cf MALF7day



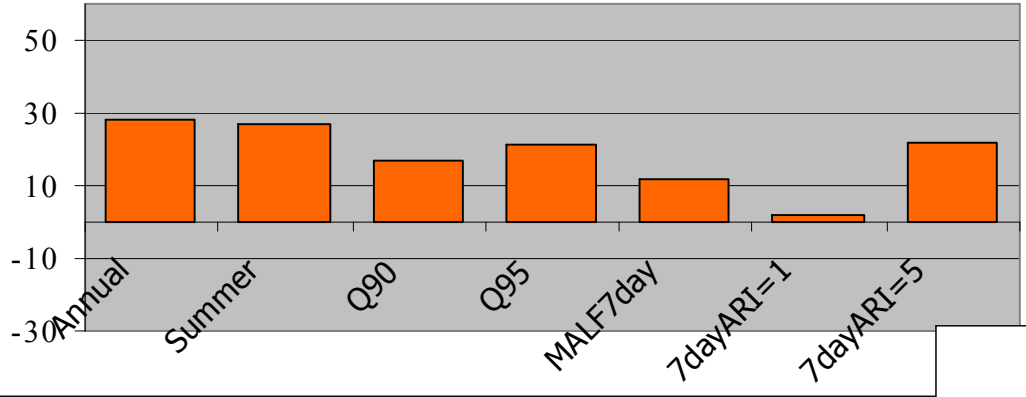
Purukohukohu



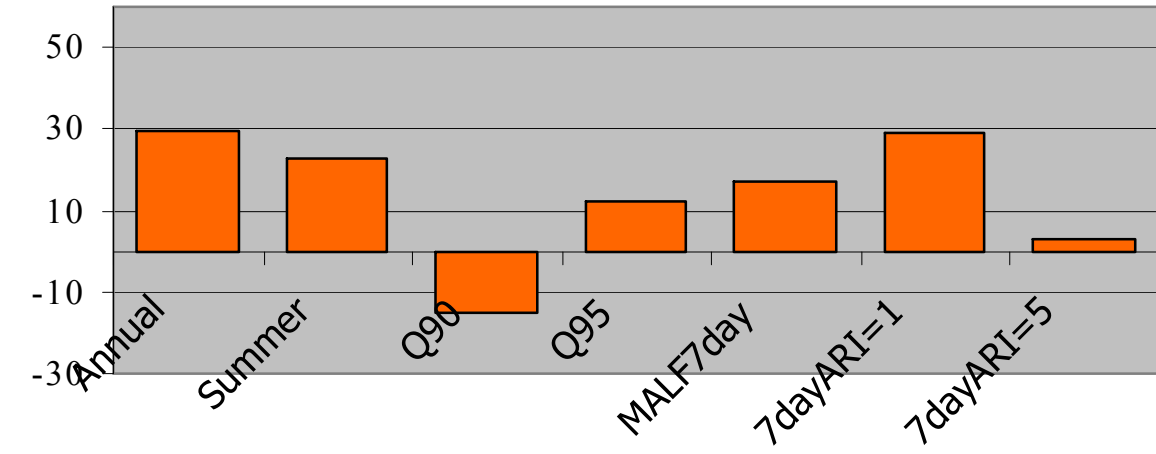
Berwick



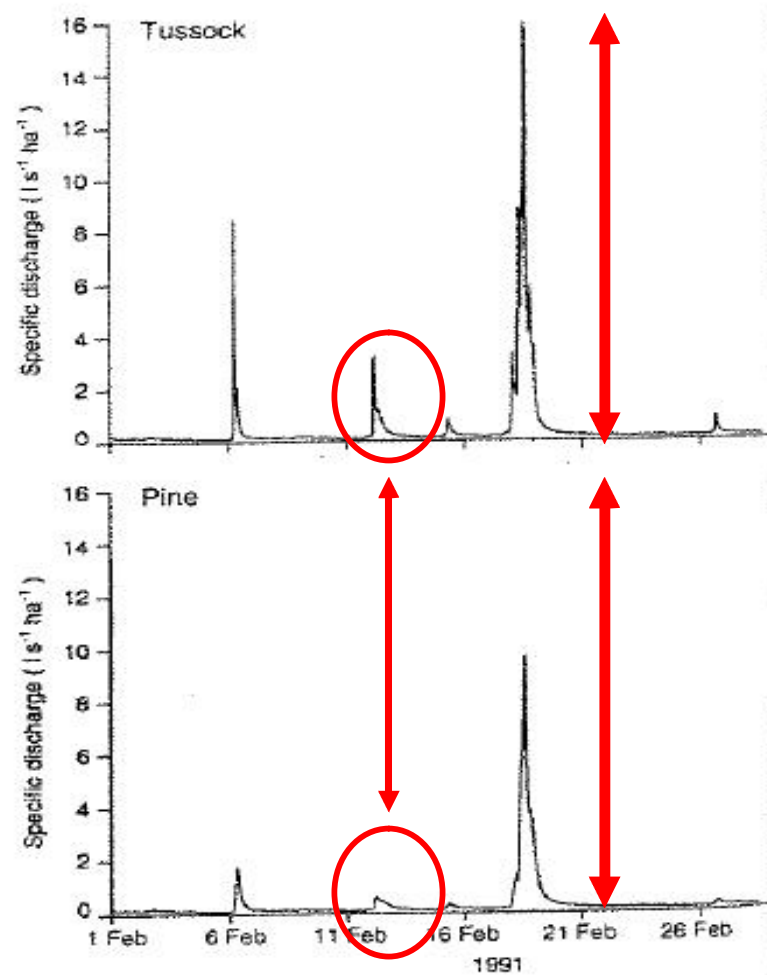
Glendhu



Kakahu



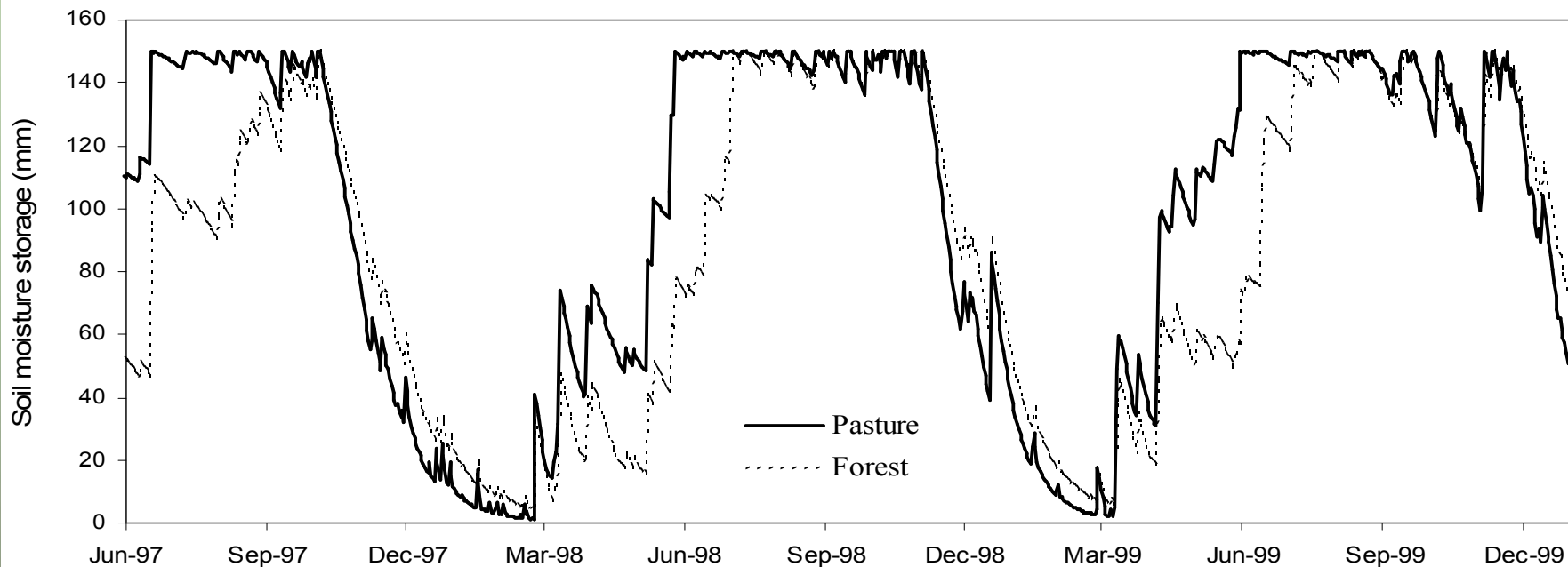
# Impact of forest cover on storm flow



**Figure 15.9** Storm hydrographs from catchments in tussock grassland and in 10-year-old *P. radiata*, Glendhu, east Otago.

# Stormflow hydrology

- Greatest effect is on small floods
  - Return period of a year or less
- Timing of when flood occurs is important
  - Main impact is through soil moisture deficit



# Sediment yield

- Many studies highlighting forestry practices
  - Roding
  - Logging operations
- Recent study looking at long term sediment yield from pasture and forestry
  - More sediment from pasture
  - Steady drip vs pulse







# Changing issues and stakeholders

- 1930s – 1985: large scale state ownership of forests
  - Catchment research answering management questions of the day
- Post 1985: private forestry companies
  - Increasing foreign ownership
  - Disinvestment in science for management
- In past 5 years starting to see removal of plantation forestry
  - Land use change: dairy conversion
  - Nutrient and water quality issues
- Reforestation for carbon sinks and biodiversity
  - Native forest regeneration on marginal land

# Summary

- Long history of catchment research on afforestation-deforestation issues
  - Consistent signal of water yield reduction
  - Majority reduction in small floods
  - Complicated in low flow area
- Sediment yield reduced following afforestation
  - Management practices main issue
  - Single pulse compared to drip of sediment
- Changing forest industry has seen a change in science emphasis and change in stakeholder group