Valuing potential benefits of weed biocontrol research
A study of Californian thistle on New Zealand lowland intensive sheep farms

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1 The Problem

Biological control can be successful, but requires investment of research money. For public agencies to invest in this research, they need to know the size of the potential economic benefit. Generating such an estimate was the focus of this research.

Californian thistle reduces the productivity of sheep farming in New Zealand, an industry worth over NZ$2 billion per year.

2 Bioeconomic model

- Spreadsheet model (Excel) with Visual Basic macros, solved with Premium Solver Platform.
- Chemical and biological weed control.
- Economics from farm production budgets.
- Biological module, based on research by Bourdôt, et al., accounted for distinctive features of Californian thistle reproduction.
- Module linkages from bioeconomic literature.

3 Model parameters

Biological
Root bud population size
Root bud production
Root bud dormancy
Weight per aerial shoot
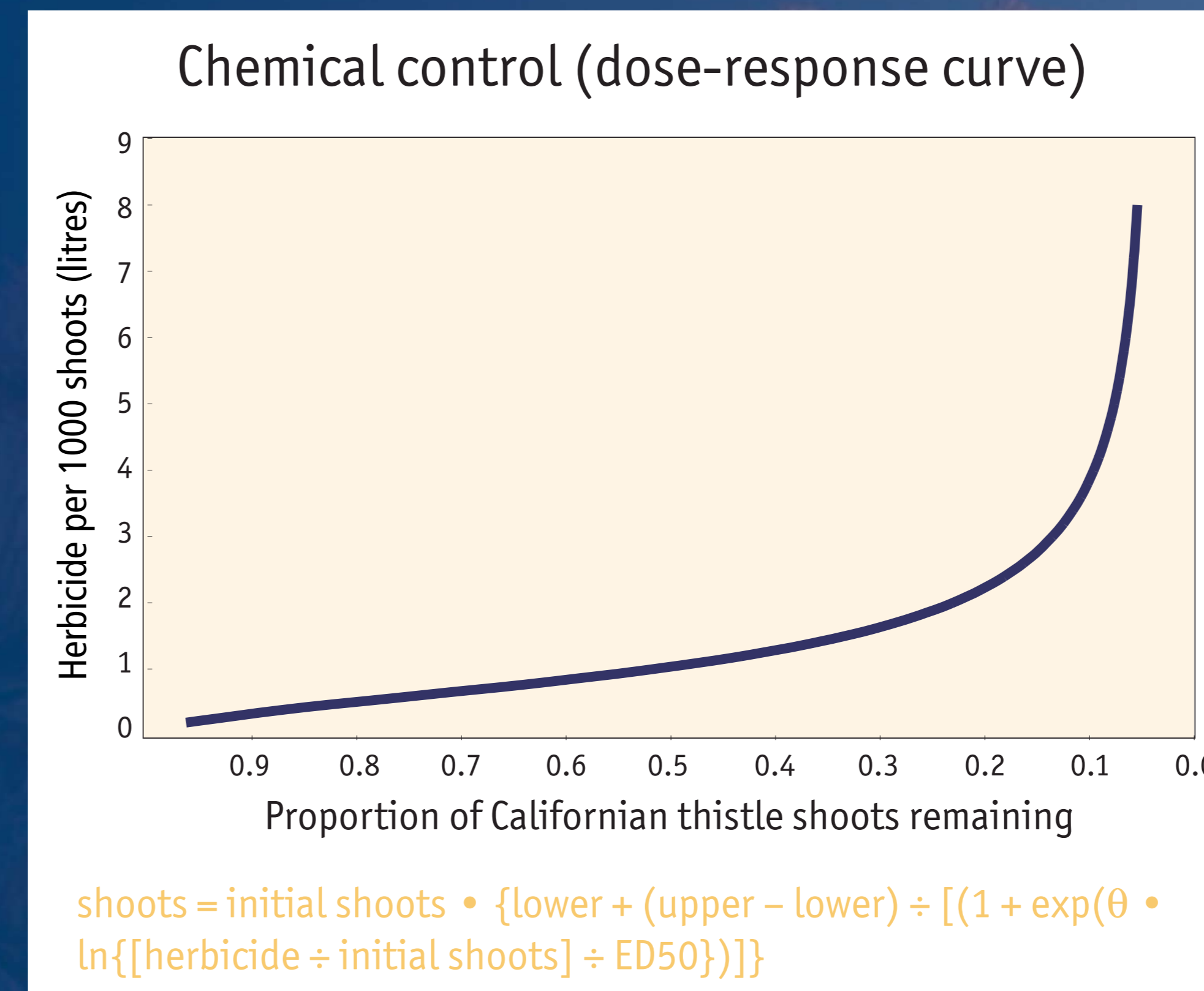Shoot mortality
Clover N fixation rate
Pasture area of impact
Shoot size

Economic
Wool clip per ewe
Pasture dry matter per ha
Ewe feed requirement
Farm size
Gross margin
Discount rate
Lamb feed requirement
Lambing rate
Lamb sales price
Ewe maintenance feed
Price of N
Wool price

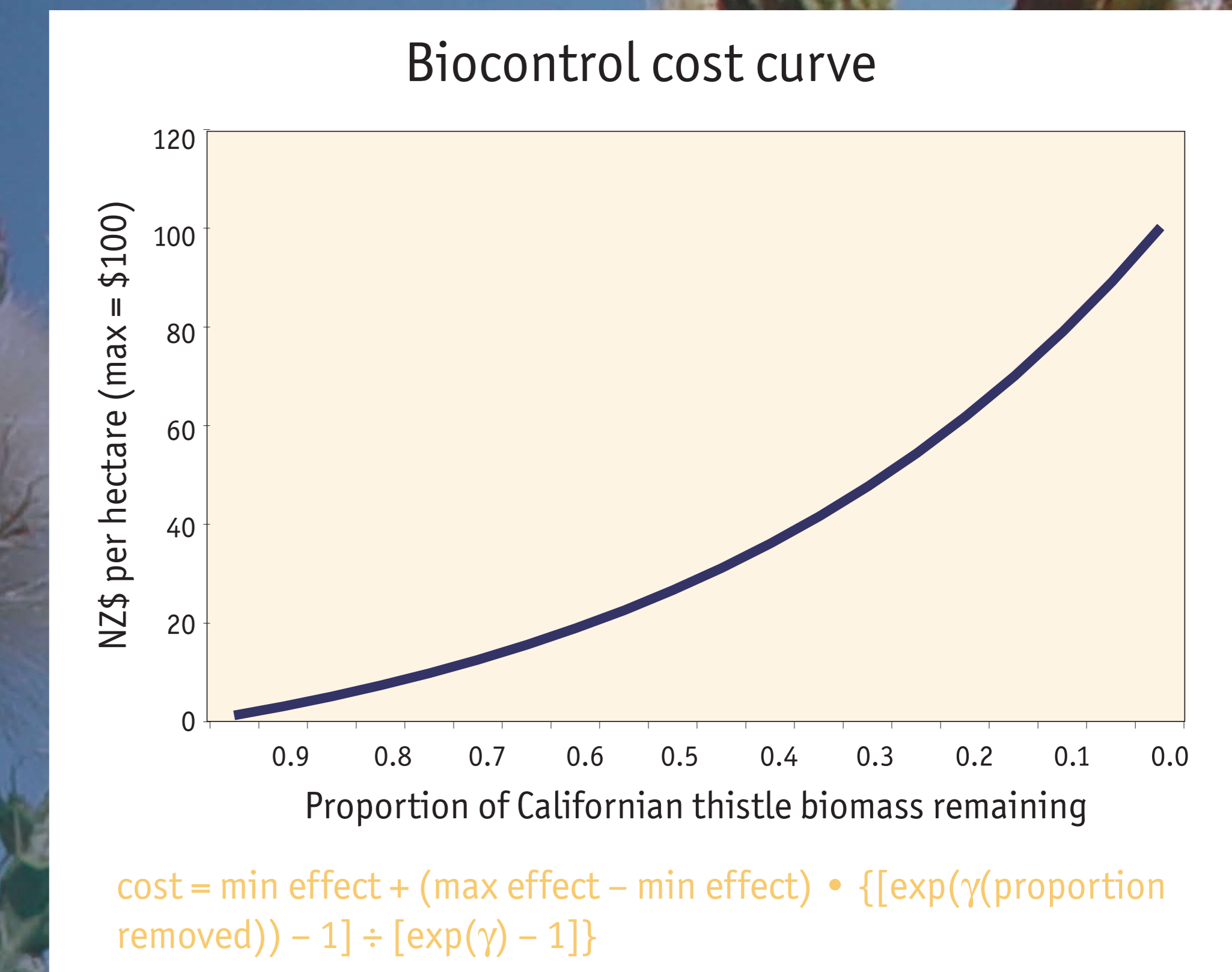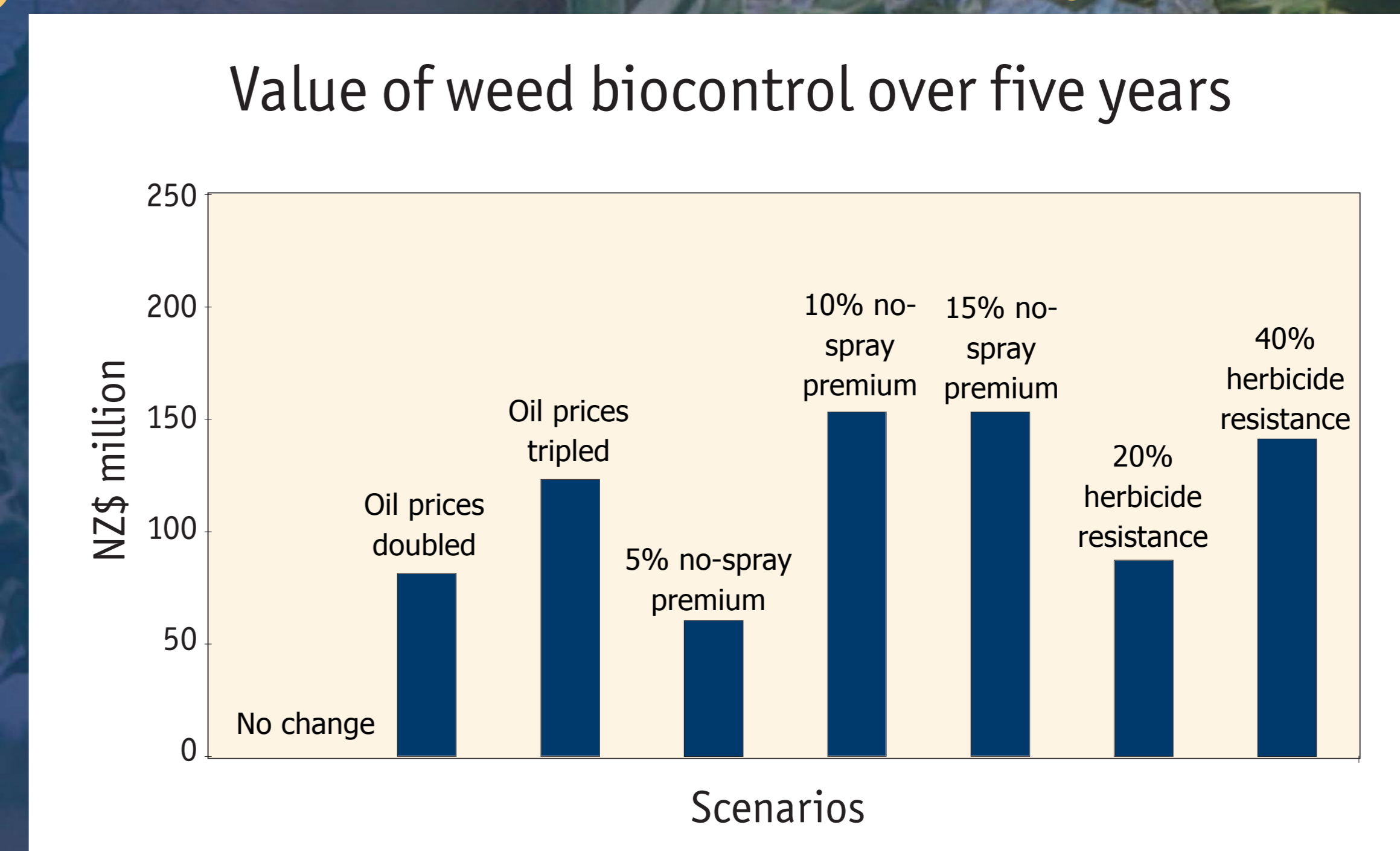Pasture infested with Californian thistle.

4a Chemical control cost

Chemical control (dose-response curve)
y-axis: Herbicide per 1000 shoots (litres)
x-axis: Proportion of Californian thistle shoots remaining

shoots = initial shoots • {lower + (upper − lower) ÷ [(1 + exp(θ • ln{[herbicide ÷ initial shoots] ÷ ED50})]}

4b Biocontrol cost

Biocontrol cost curve
y-axis: NZ$ per hectare (max = $100)
x-axis: Proportion of Californian thistle biomass remaining

cost = min effect + (max effect − min effect) • {[exp(γ(proportion removed)) − 1] ÷ [exp(γ) − 1]}

5 Value of biocontrol over 5 years

Value of weed biocontrol over five years
y-axis: NZ$ million
x-axis: Scenarios

No change
Oil prices doubled
Oil prices tripled
5% no-spray premium
10% no-spray premium
15% no-spray premium
20% herbicide resistance
40% herbicide resistance

6 Findings

- **Biocontrol of Californian thistle in lowland sheep farming in NZ worth from NZ$0 to NZ$153 million over five years.**
- **Biocontrol useful strategy for reducing economic risk.**
- **Key variables: petroleum prices, herbicide resistance, consumer demand.**

Key References

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