

Trials without tribulation: robust active adaptive management

Michael McCarthy and Brendan Wintle



Walters and Holling

- management as experiments
- planned learning
- trial multiple management strategies
- not blind trial and error

efficiency of learning

Merri Creek revegetation



Merri Creek revegetation

options

- high density planting (~4,000 / ha)
- low density planting (~2,000 / ha)

success

- achieve a particular density
- could include other requirements

budget of \$40,000

costs

- high density (\$4,000 per ha)
- low density (\$2,000 per ha)

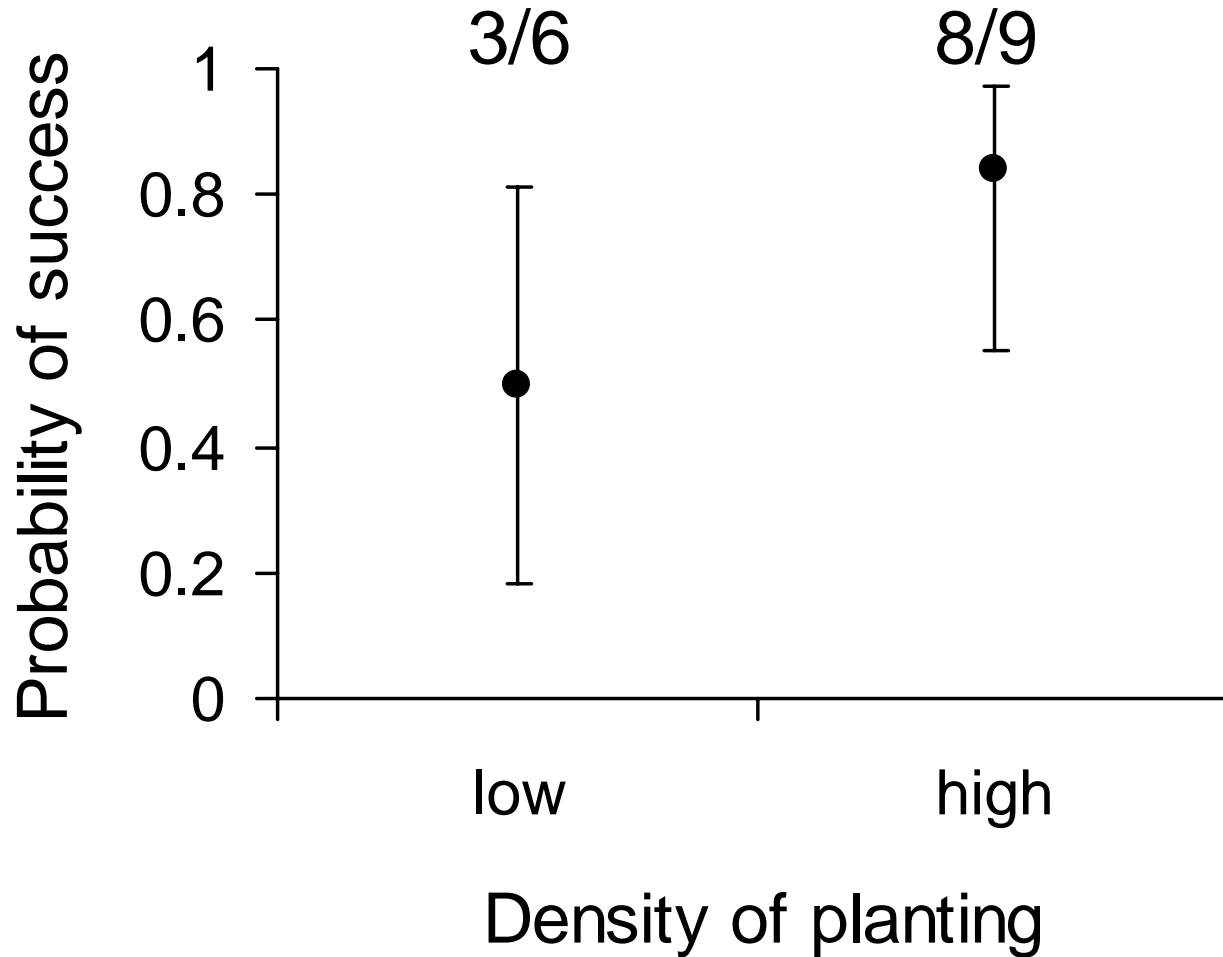
success

>1,500 surviving plants per ha

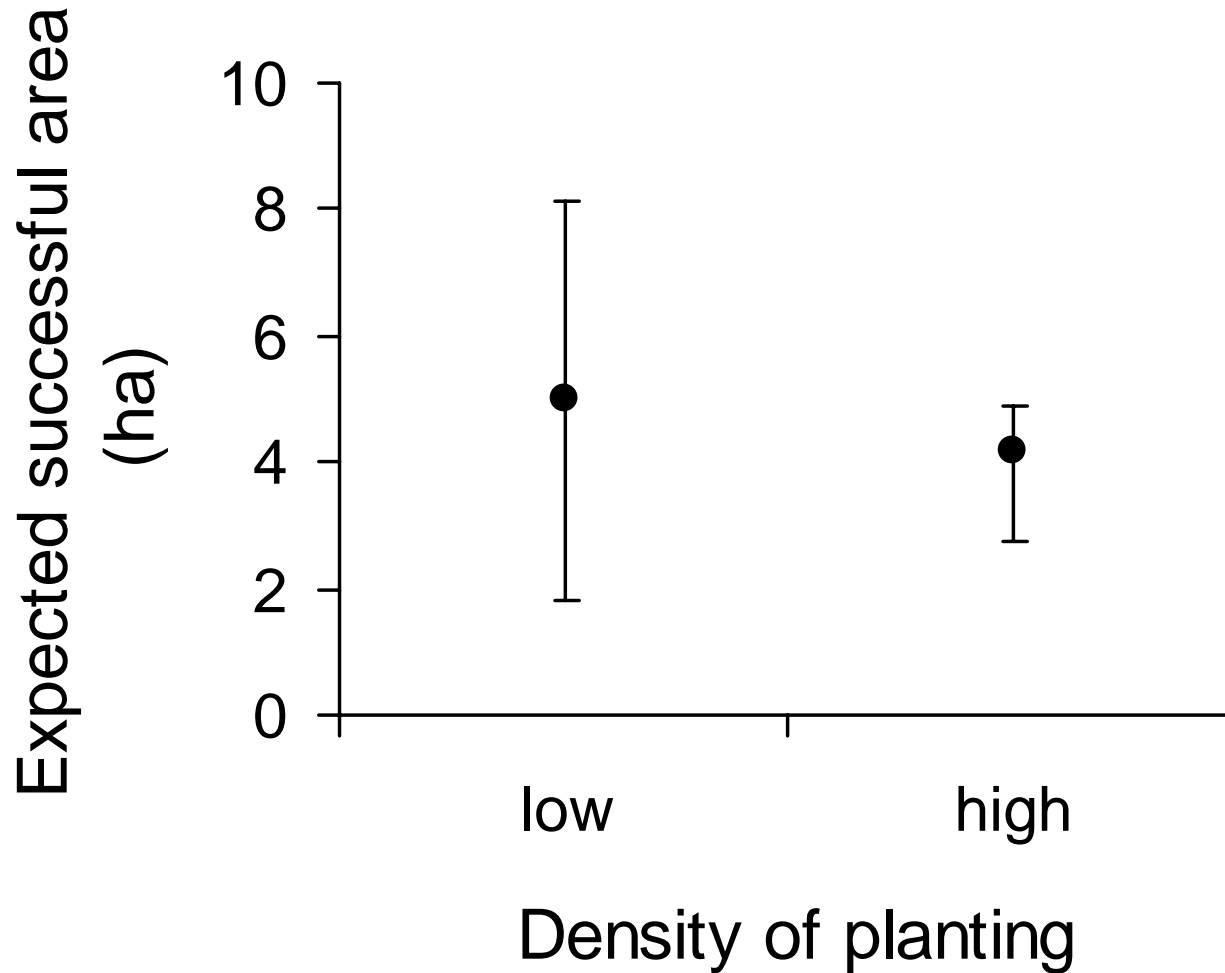
objective

- expected area of successful revegetation over next 2 periods

Uncertain success



Uncertain outcome



Model of learning

Bayesian updating

number of successes is beta-binomial

$$g(s) = \Pr(S = s) = \frac{n!}{s!(n-s)!} \frac{B(s+a, n-s+b)}{B(a, b)}$$

s = number of successes from n trials

$a-1$ = number of previous successes

$b-1$ = number of previous failures

Expected success

$$E(S | x_1, x_2) = x_1 + x_2 + (B - n_1 - n_2) \times \max(\mu_1, \mu_2)$$

- [for equal costs]

$$\mu_j = (a_j + x_j) / (a_j + b_j + n_j) \quad [\text{mean of beta}]$$

$$E(S) = \sum g(x_1) \times g(x_2) \times E(S | x_1, x_2)$$

Info-gap model

envelop bound for a_1, a_2, b_1, b_2

robustness: maximum horizon of uncertainty such that the expected area of successful planting is sure to be suitably large

decision, resource allocation in first time period (option 1 and 2), leaving resources for the second (option to be chosen)

