

# A decision-tool for adaptive renewable resources management

Erling Moxnes, SNF, Norway

Öje Danell, University of Uppsala, Sweden

Eldar Gaare, NINA, Norway

Jouko Kumpula, Finnish Game and  
Fisheries Research Institute, Finland

Corresponding author: Erling Moxnes

Breiviksveien 40, 5045 Bergen

+47 55959526 (fax -439)

[Erling.Moxnes@snf.no](mailto:Erling.Moxnes@snf.no)

## How to deal with complexity?

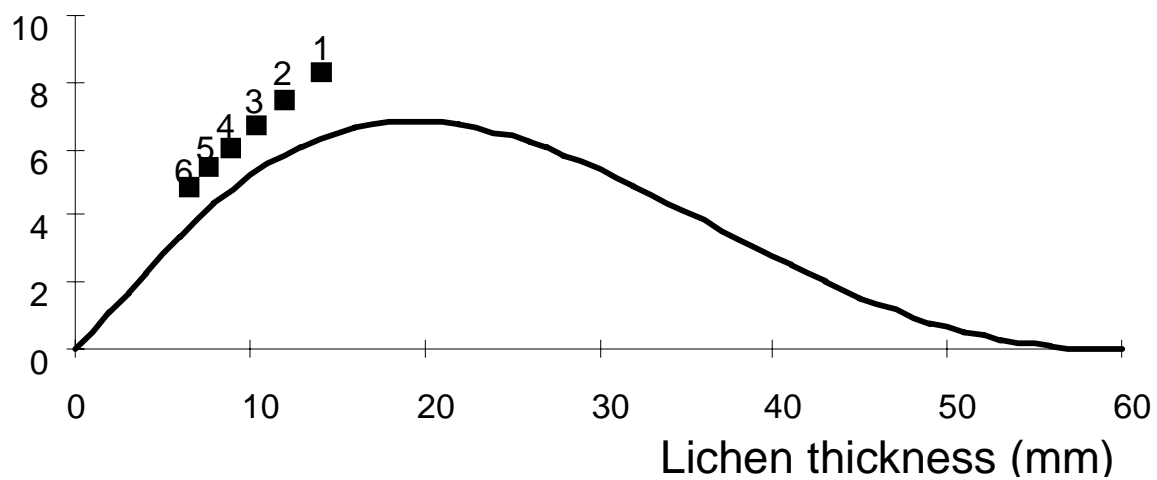
- Experiments show that management of renewable stock resources is complicated, Moxnes (98) and Moxnes (98).
  - dynamics (stocks and flows)
  - non-linearities
  - uncertainty and risk
  - learning
- What to offer clients with limited budgets?
  - Simulation studies
  - Optimization studies
  - Group model building
  - Simulators
  - Simplification and client involvement (based on previous four)

# Adaptation of reindeer herd size to lichen availability

- Key problem found in experiments: An unknown, non-linear, growth relationship

$$dL / dt = g(L) - c(N)$$

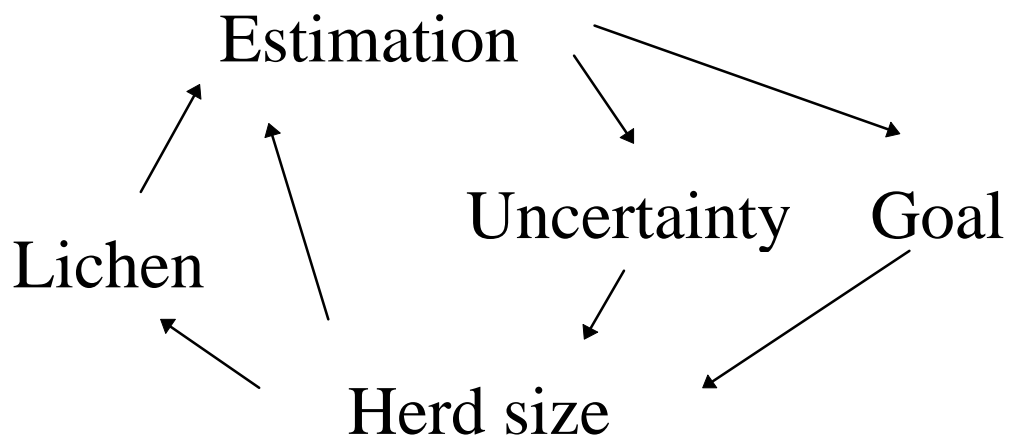
Consumption and growth (mm/year)



## Simplifications in decision-tool

- From complex optimization under uncertainty, Moxnes et al.(99):
  - Appropriate to aim for maximum sustainable yield for lichen
- From complex Bayesian estimation:
  - Adjust a few key parameters in the priors for lichen growth to fit available data
- From complex adaptive management (optimal management and learning)
  - Manipulate the herd size to get growth data for different levels of lichen (i.e. deviate from maximum sustainable yield)

# Working of tool: Adaptive management

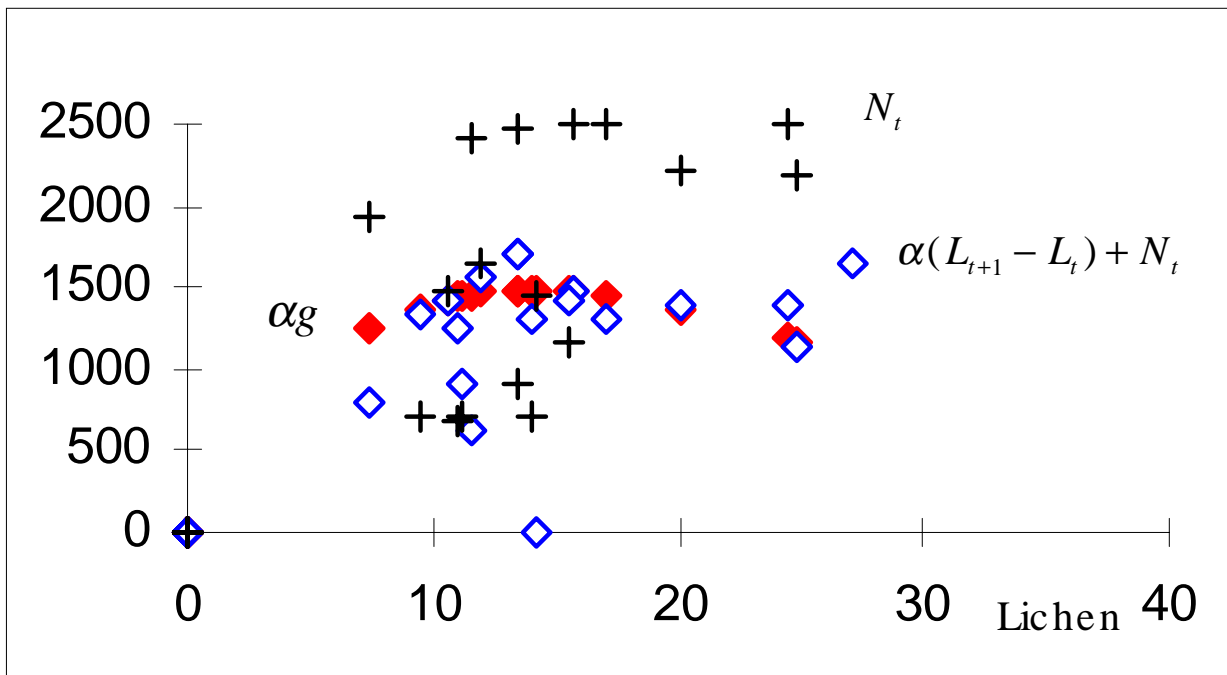


# Bayesian calibration

$$Ag(L_t) = A(L_{t+1} - L_t) + c_0 N_t$$

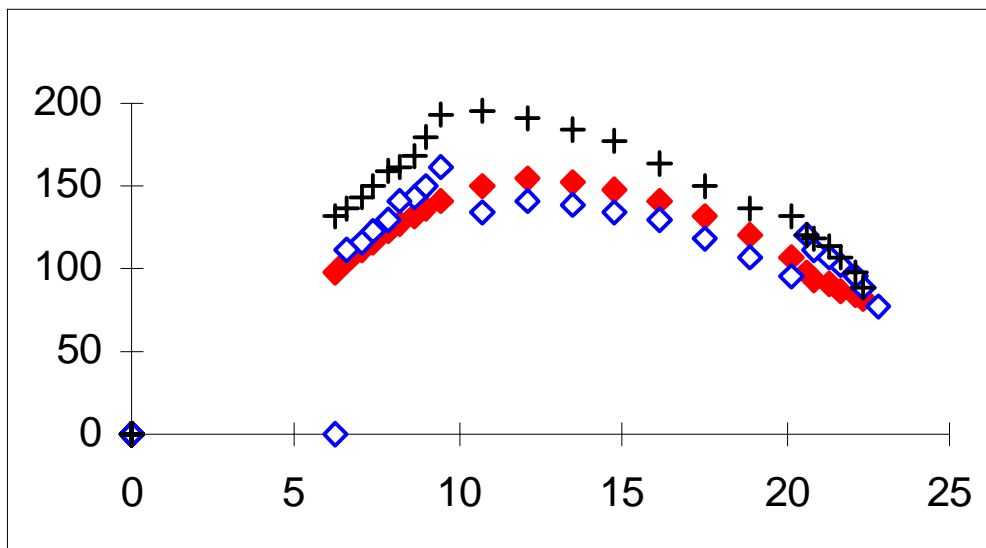
$$\frac{A}{c_0} g(L_t) = \frac{A}{c_0} (L_{t+1} - L_t) + N_t$$

$$\alpha g(L_t, \beta) = \alpha (L_{t+1} - L_t) + N_t$$



# Testing/Use

- Simulator generates data for testing, and can be used for training sessions
- Test with 10 students, each with 6 trials:
  - key parameters were found with an average accuracy of 15 to 20 percent.
- To be tested in all Nordic countries



- Hopefully, the tool will:
  - generate client involvement in the production and analysis of crucial data
  - structure data such that proper policies follow naturally