Monsu

A management information system for multiple-use forestry

Timo Pukkala
Contents

- Background
- Monsu tools
  - Simulation tool
  - Planning tools
  - Decision support tools
Planning and decision analysis

- **Planning**
  - finds the *optimal* way to use resources
  - optimality depends on *preferences*
  - always optimisation
  - always utility maximisation

- **Decision analysis**
  - all analyses that precede decision
  - includes planning, *plus*
  - analysis of preferences, qualitative evaluations, etc.

- **Decision is subjective**
Planning and decision-analysis

- Decision maker
  - Preferences
    - Objectives and constraints
  - Forest ecosystem
    - Inventory data
    - Models
      - Information about alternatives
- Comparisons
- Decision
Quantitative approach to planning

- Define the problem
- Develop a model
- Acquire input data
- Develop a solution
- Test the solution
- Analyse the results
- Implement the results
Information systems used in planning

- Decision Support System
- Planning System
- Simulation System
- Data Management System
- Measurement System
- Forest Ecosystem
Monsu simulation tool

- Treatment schedules for stands
  - Automatically
  - Manually

- Information for the planning model

- Results in a Decision Space
What is simulated

- Initial stand
  - stand-level data, tree-level growth models
  - diameter distribution predicted
  - calibrated using GP

- Stand development
  - regeneration
  - growth
  - mortality

- Treatments
  - cuttings, growing stock treatments
  - site treatment
What else is predicted for schedules?

- **Multiple-use variables**
  - Berry yields
    - expert models
  - Mushroom yields
    - empirical models
  - Scenic beauty and recreation scores

- **Ecological variables**
  - Deadwood volumes
  - Volumes of “unimportant” species
  - Habitat suitability indices
  - Stand “oldness”
Monsu planning tools

- Planning model writer
  - writes a planning model using
    - information from simulations
    - information on preferences

- Solvers
  - mathematical programming
  - heuristics
Solvers

- Mathematical programming
  - LP & GP
- Heuristics
  - Random ascent
  - Hero (systematic ascent)
  - Simulated annealing
  - Tabu search
  - Genetic algorithms
  - Hybrids
Heuristics maximise utility function

\[ U = w_1 u_1 \text{(Income)} + w_2 u_2 \text{(Recreation)} + w_3 u_2 \text{(Biodiversity)} \]

\[ U = \sum_{k=1}^{m} w_k u_k (q_k) \]
Multiple-use objectives, examples

- Mean berry yield

- Location-weighted mean recreation score
  - Location weight may depend on
    - visibility
    - proximity
    - subjective considerations
Multiple-use example
Ecological objectives, examples

- Deadwood volume
- Area of old forest
- Habitat area

- Spatial autocorrelation
  - Moran’s I

- Habitat–Habitat boundary
- Habitat–Non-habitat boundary
Spatial objectives need adjacency information
Ecological goal examples
Additional decision support tools

- User-friendly interface
  - “Visual interface for interactive multi-objective multi-party optimisation”

- Visualisation tool
Monsu planning interface

If not good, change weights or target levels …
Visualisation, close views
Distant view