Measurement and Analysis Issues for Complex Stands

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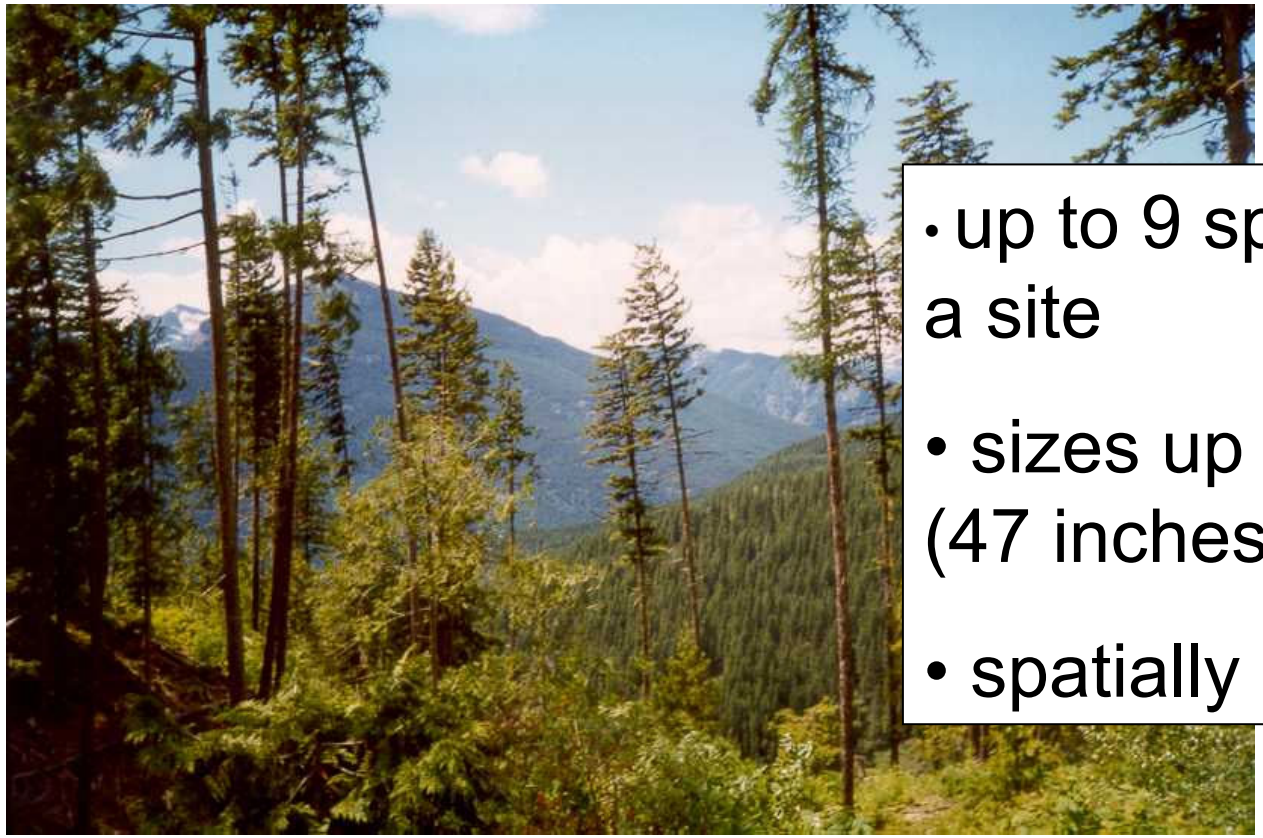
Complex (Irregular) Stands:

- Multi-aged
- Many species
- Diverse arrangements in space

Can be Natural

Example: Interior Cedar Hemlock, Southeastern BC, Canada



- up to 9 species on a site
- sizes up to 120 cm (47 inches) dbh
- spatially diverse

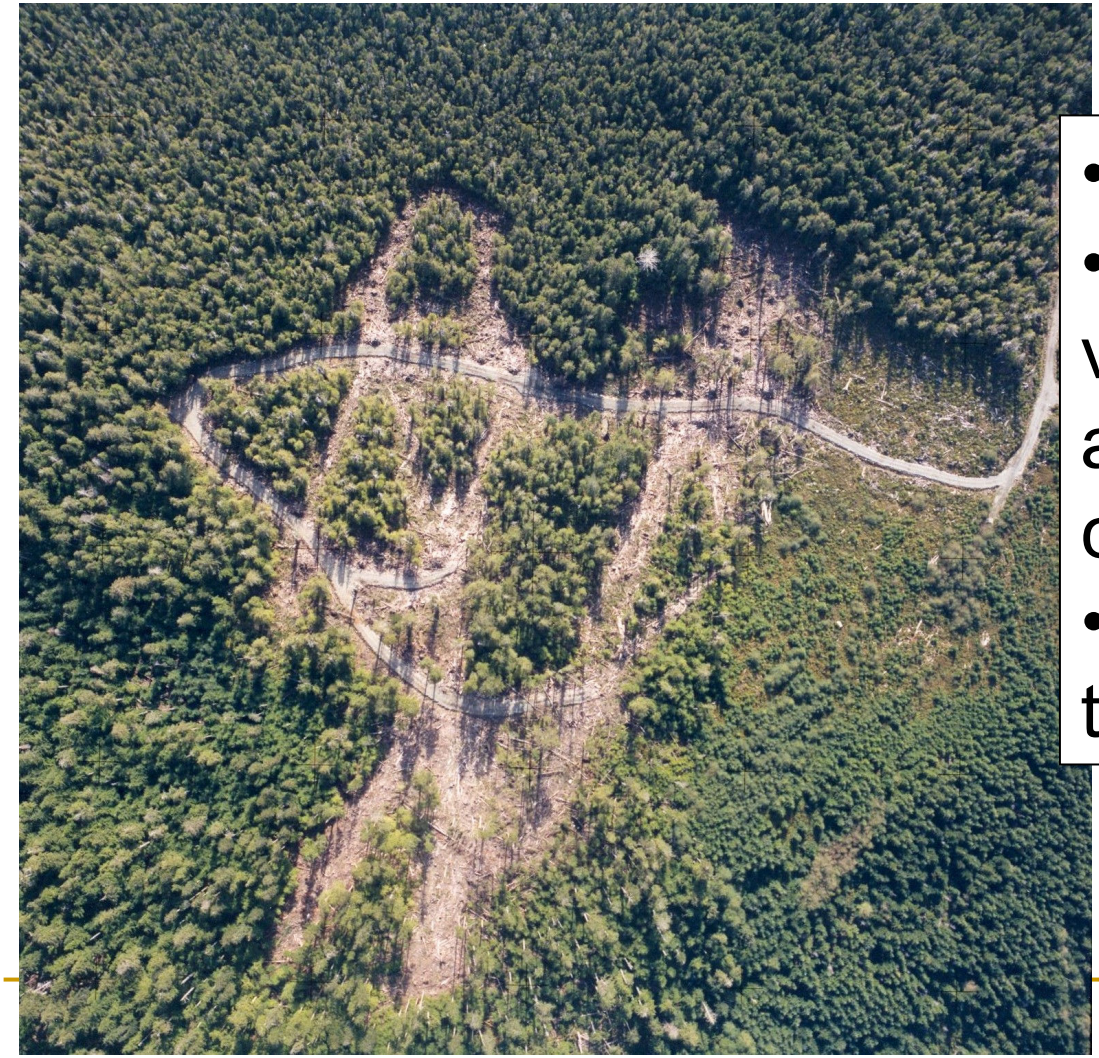
Or Created: Via Partial cutting

Partial cutting in Uneven-aged Douglas-fir, Northeast BC, Canada

- Thinning from below to improve stand structure, function and productivity

Created: via Harvesting

Retention Harvests, Coastal BC, Canada



- Wildlife use
- High spatial variability of trees and road/ corridor network
- "Edges" difficult to define

Created: via Mixed-Species Plantations

Mixed Species Plantation, Switzerland

- More regular spacing and single-aged
- Replacing single species/ even-aged plantations

Questions About Complex Stands

- Regeneration – where, how much, and what kind?
- Impacts of cutting and treatments on growth, regeneration, mortality
- Diversity of other vegetation? Animals?

Measurement and Analysis Issues

Very High Variation

Natural

- large due to species, ages, spatial patterns

Created

- More variability in mixed-species than single species plantations
- Sometimes more spatial variability than “natural” forests, examples:
  - Retention harvests
  - Partial cutting in stands where fires are the dominant disturbance regime

Wide Variety of Management Regimes

- Planted/regenerated species mixtures
- Cutting patterns
- Vegetation control -- many methods

Short term vs. long term

- Short term trials infer long term results?
- Longer time needed for complex stands?
- “Preserving”, funding and protecting trials over longer terms?

Changes in Measurements and Analysis

Variability in Experiments

- Experimental units' size
  - Few large units
    - Low power
    - Captures scale of variability
    - Difficult to find homogeneous units
  - Many small experimental units – results may not be very "realistic; may give insights
- More split experimental plots for some factors
- Rely more heavily on "blocking"

Variability in Experiments

- Add more covariates to reduce variance
- More use sub-sampling to reduce measurement costs
- Include spatial co-ordinates of trees, regeneration, snags, etc. – more feasible with newer electronic devices and may replace blocking?

Variability in Sampling

- Very high spatial variability – modify sampling designs e.g., Kim Iles and Nick Smith for variable retention areas
- Reduce measurement costs and increase number of experimental units via electronic measuring – e.g., Bill Carr – new relascope

Wide Variety of Management Regimes in Experiments

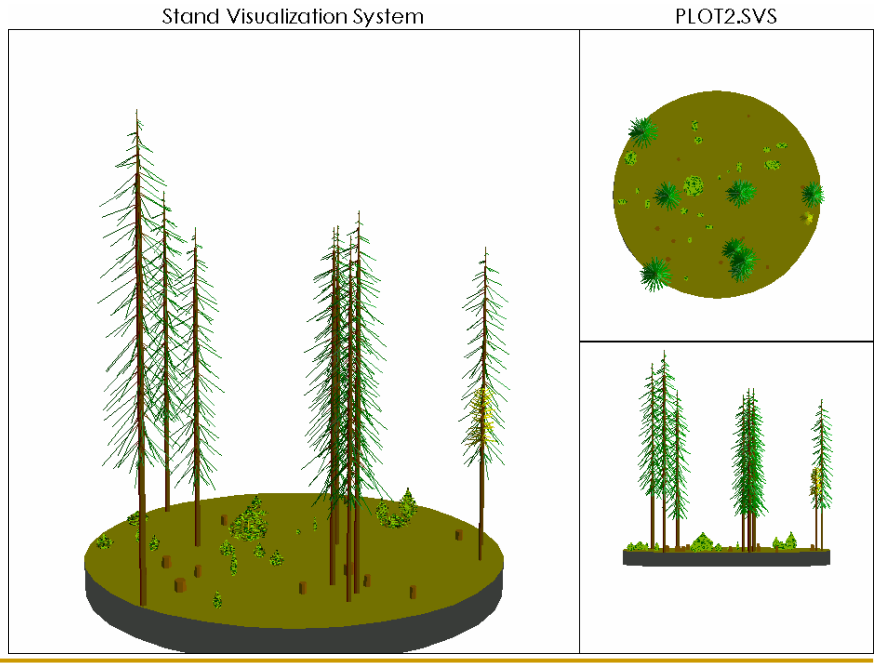
- Include only “extremes” of management practice? Who will allow these experiments on their forested land?
- Use of Nelder plots and Scotch plaid designs, etc. for a wide variety of densities and mixtures of species on small land areas

Longer Time Periods

- Not likely to secure longer term funds
- Switch to retrospective data: get long- term data promptly via destructive analysis –
  - Won’t know conditions during growth
  - Often not able to get “response”
- Change analyses method(s)

Alternative Analyses for Complex Stands

- Change Expectations: Use simple graphs to illustrate measures and results



Alternative Analyses for Complex Stands

- Use mixed modelling approaches to deal with:
  - Sub-sampling and estimating variances at different scales
  - Spatial and temporal correlation
- Use Meta-analysis – pool results from many small “classical” experiments together (Peter Newton, Forestry Canada)

Alternative Analyses for Complex Stands

- Use data from experiments and observational data in a model:
  - wider ranges within data
  - difficult to get at “response” to treatment (e.g., work by Albert Stage, USFS)

Alternative Analyses for Complex Stands

- Virtual Experiments – use models to simulate results of interventions (management)
  - Process or hybrid models – may be “better” for extending beyond the range (time, space, variable spaces) to simulate experiments
  - Must check this against reality somehow

What's Next?

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Experimental Design and Analysis:

- Continue small scale detailed experiments for "process" questions – try to secure long term funding?
- Use spatial data and better tools for analysis?
- More use of Meta-analysis

What's Next?

Modelling –

- More use of retrospective data?
- More hybrid models -- to do "virtual experiments"

Sampling – better methods for sampling very high spatial variability?

Participants of the Workshop have:

- Proposed a meeting to discuss these issues for IUFRO 2005 in Brisbane
- Proposed a discussion paper to summarize the issues