

North American Forest Ecology Workshop

June 2007

From Science to Sustainability

Forest Science Center, UBC

Bioenergy as an Ecosystem Management Product

- Wood was the major energy source for early civilizations
- Displaced for centuries in many countries by water, coal, natural gas and/or nuclear power
- Interest returned in '70s - the threatened Arab oil embargo
- Current interest is closely related to environmental concerns over climate change

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Take home message from my talk:

Current and future forest bioenergy strategies must address ecosystem sustainability and the many values of forest ecosystems

Definition of Forestry

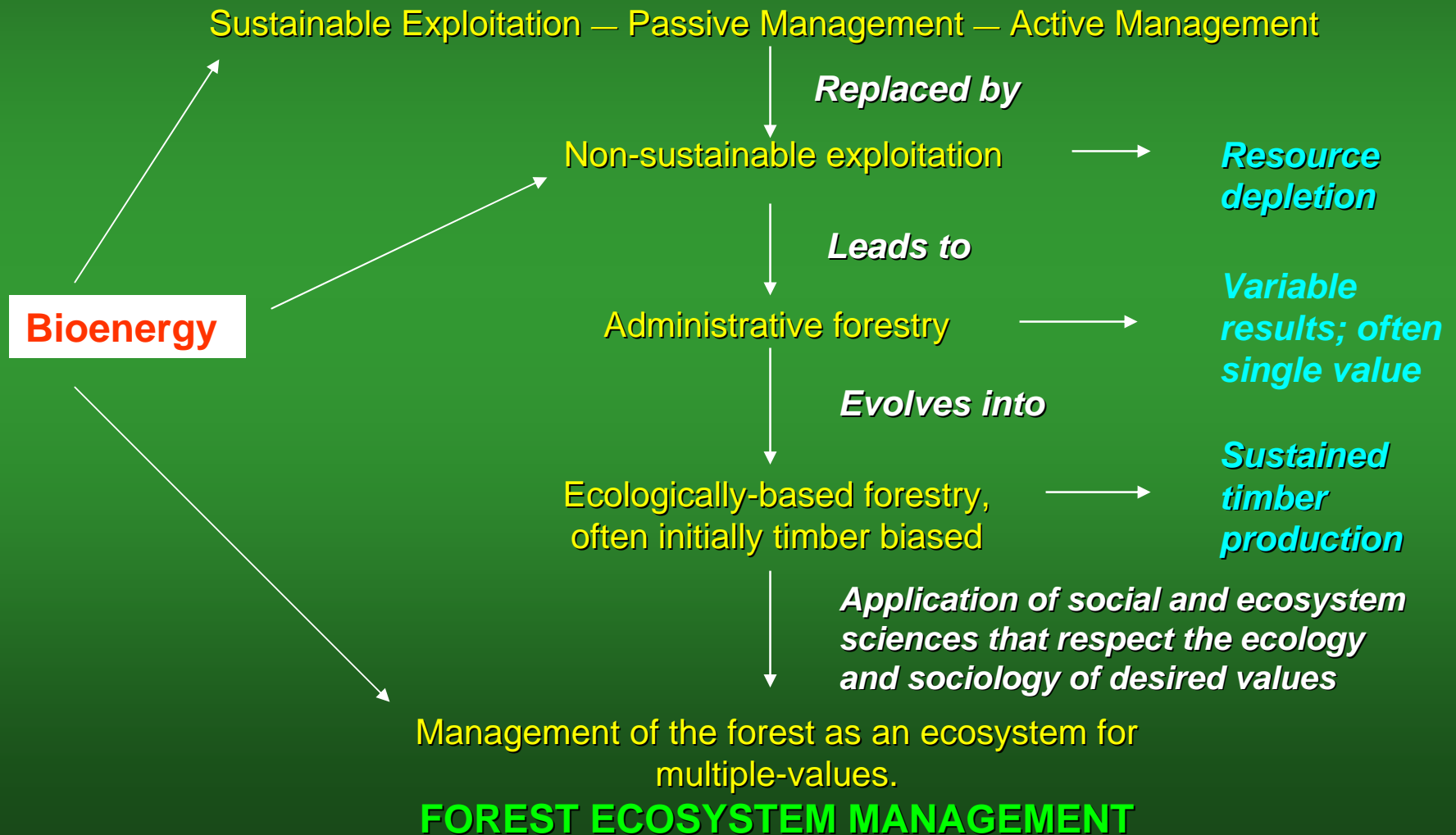
- The art (skill), practice, science and business of managing forested landscapes to sustain a desired balance of ecologically possible values and environmental services from that landscape.

The Two Responsibilities of Forestry

1. To change the way in which a forest is managed as the desired balance of values and environmental services changes.
2. To reject current practices and resist proposed new practices that are inconsistent with the ecology and sociology of the desired values and services over ecologically appropriate temporal and spatial scales.

This requires that forest bioenergy be developed in the context of ecosystem management

The Evolution of Forest Ecosystem Management



What is Forest Ecosystem Management?

- **Managing forests as integrated systems to sustain multiple values** – *not managing individual values*

Forestry is about people - values, needs, desires - and sustaining the ecosystems on which these are dependent

Wood

Recreation

Non-timber botanical products

Aesthetics

Water

Wildlife

Biological conservation

Employment

Ecosystem processes

Spiritual values

Economics - wealth creation

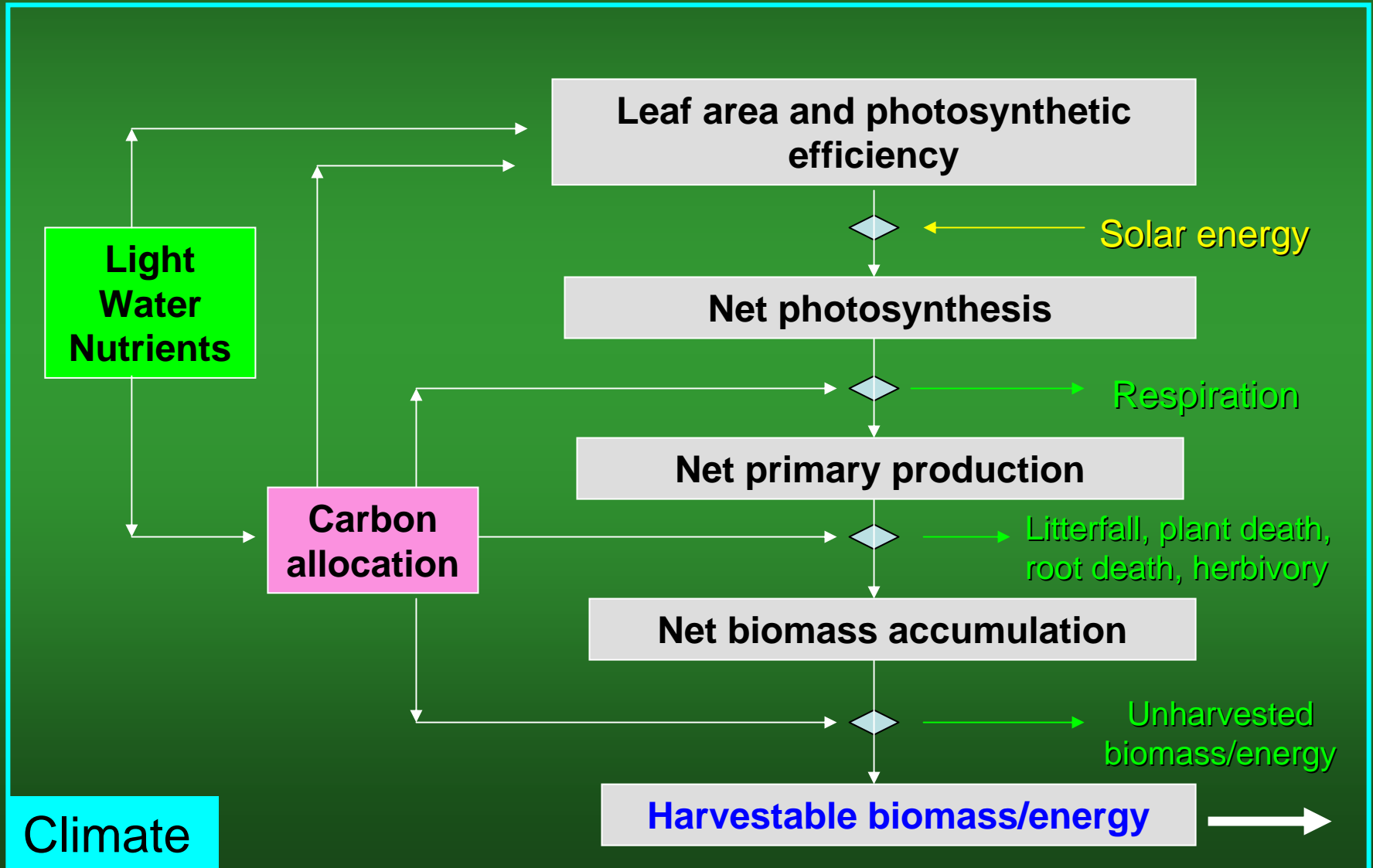
Environmental protection

Bioenergy

What is Forest Ecosystem Management?

- **Managing forests as integrated systems to sustain multiple values** – *not managing individual values*
- **Managing ecosystem processes** – *energy and change*

Forests as Energy Systems



What is Forest Ecosystem Management?

- **Managing forests as integrated systems to sustain multiple values** – *not managing individual values*
- **Managing ecosystem processes** – *energy and change*
- **Managing at multiple scales** – *space and time*
- **Examining value tradeoffs** – *multi-value decision support tools*
- **Adaptive management** – *monitoring/temporal fingerprints*

Use of ecosystem-level decision support tools and advanced visualization communication tools

Impediments to Ecosystem Management

- Lack of public trust
- Lack of appropriate tenures on public land
- Lack of experience and institutions for managing multiple values under a single plan
- Failure of science to support system-level thinking and planning – “jigsaw puzzle” science and education
- Failure to use multi-value ecosystem management planning tools

Ecosystem Management and Bioenergy Scenario Analysis Tools

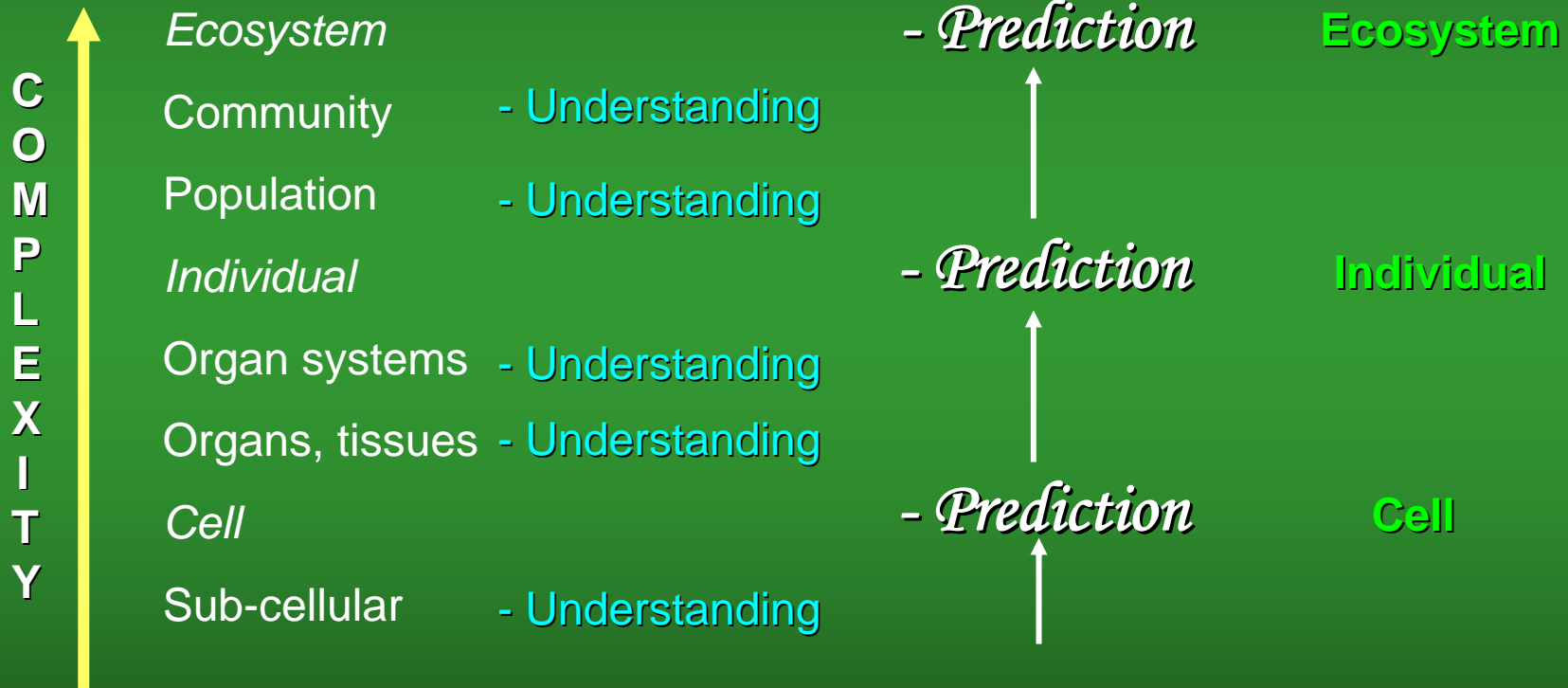
- Appropriate complexity level

As simple as possible, but as complex as necessary – Occam

As simple as possible, but no simpler - Einstein

Levels of biological organization

Levels of biological integration



The need for the ecosystem level: PREDICTION

Ecosystem Management and Bioenergy Scenario Analysis Tools

- Appropriate complexity level
- Key processes

Primary production – energy and nutrients

Ecosystem disturbance and change - succession

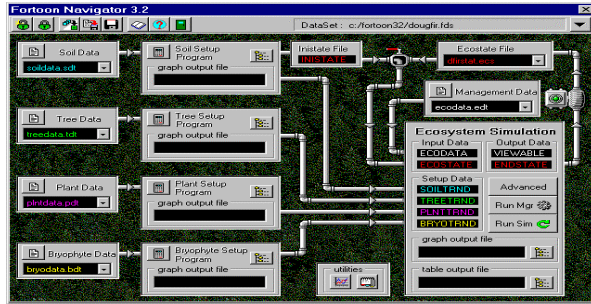
Ecosystem Management and Bioenergy Scenario Analysis Tools

- Appropriate complexity level
- Key processes
- Various spatial scales

Individual trees, stands, cutblocks, local landscapes, watersheds and larger landscapes

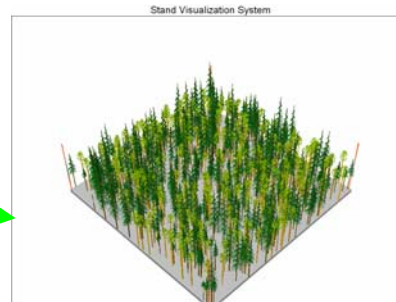
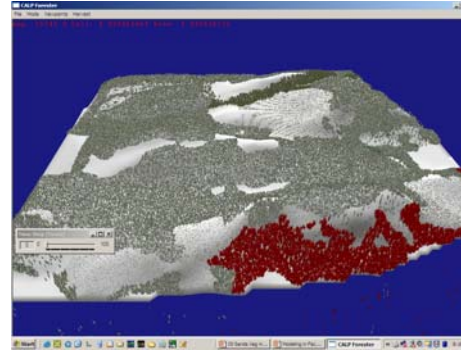
FORECAST

Non-spatial ecosystem management stand model

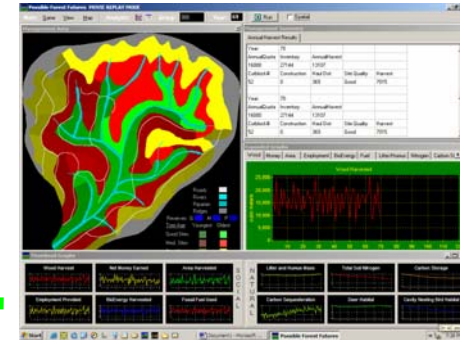


FORCEE:
Individual tree,
complex stand model

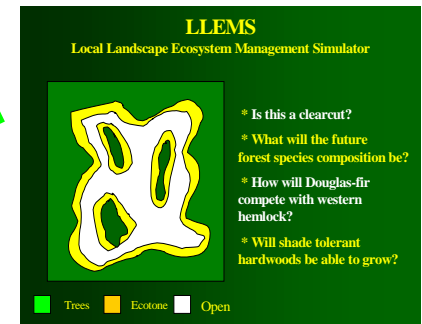
**LLEMS Visualization
software – stand and
landscape**



**POSSIBLE FOREST
FUTURES:
watershed landscape
management model**



**LLEMS: local
landscape/complex
cutblock simulator**

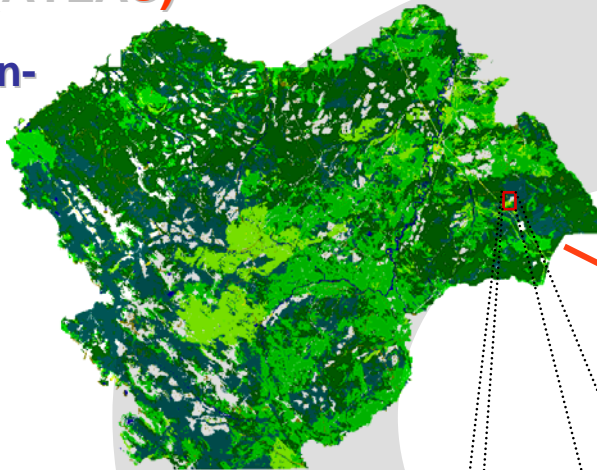


DECISION SUPPORT SYSTEM: **Modelling Framework**

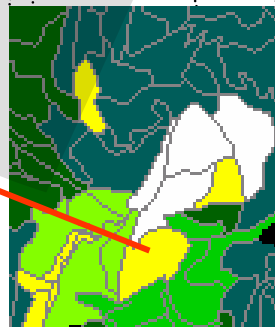
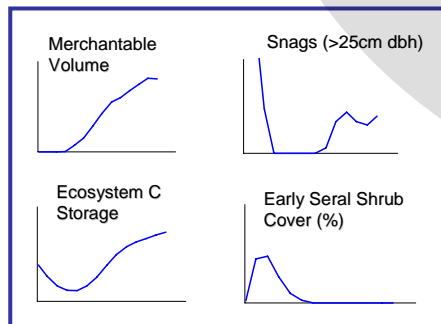
Projection

**Forest-level Model
(ATLAS)**

**Polygon-
Based**



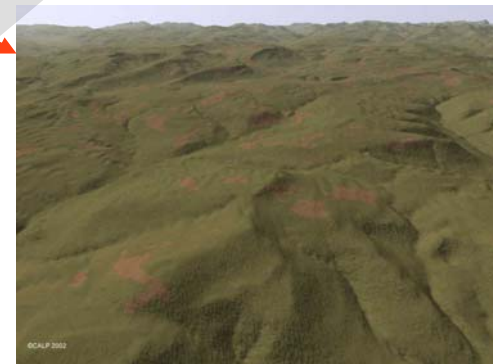
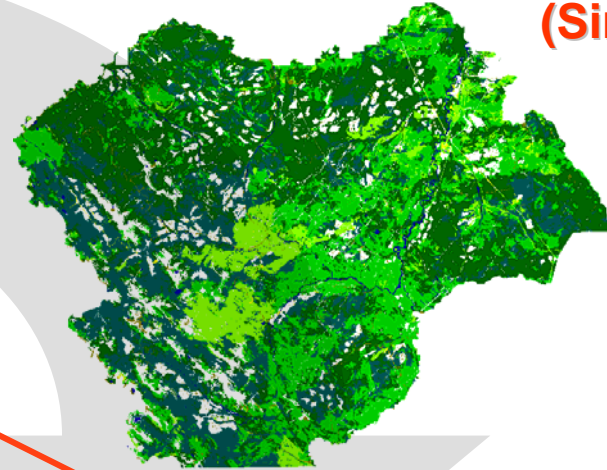
**Stand-level Model
(FORECAST)**



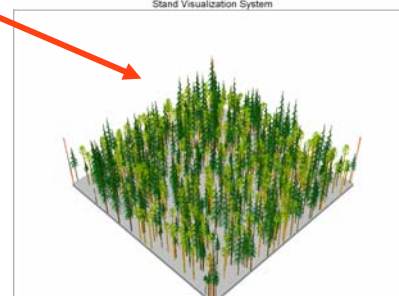
Interpretation

**Habitat Model
(SimFor)**

**Raster-
Based**



**Visualization
Software**

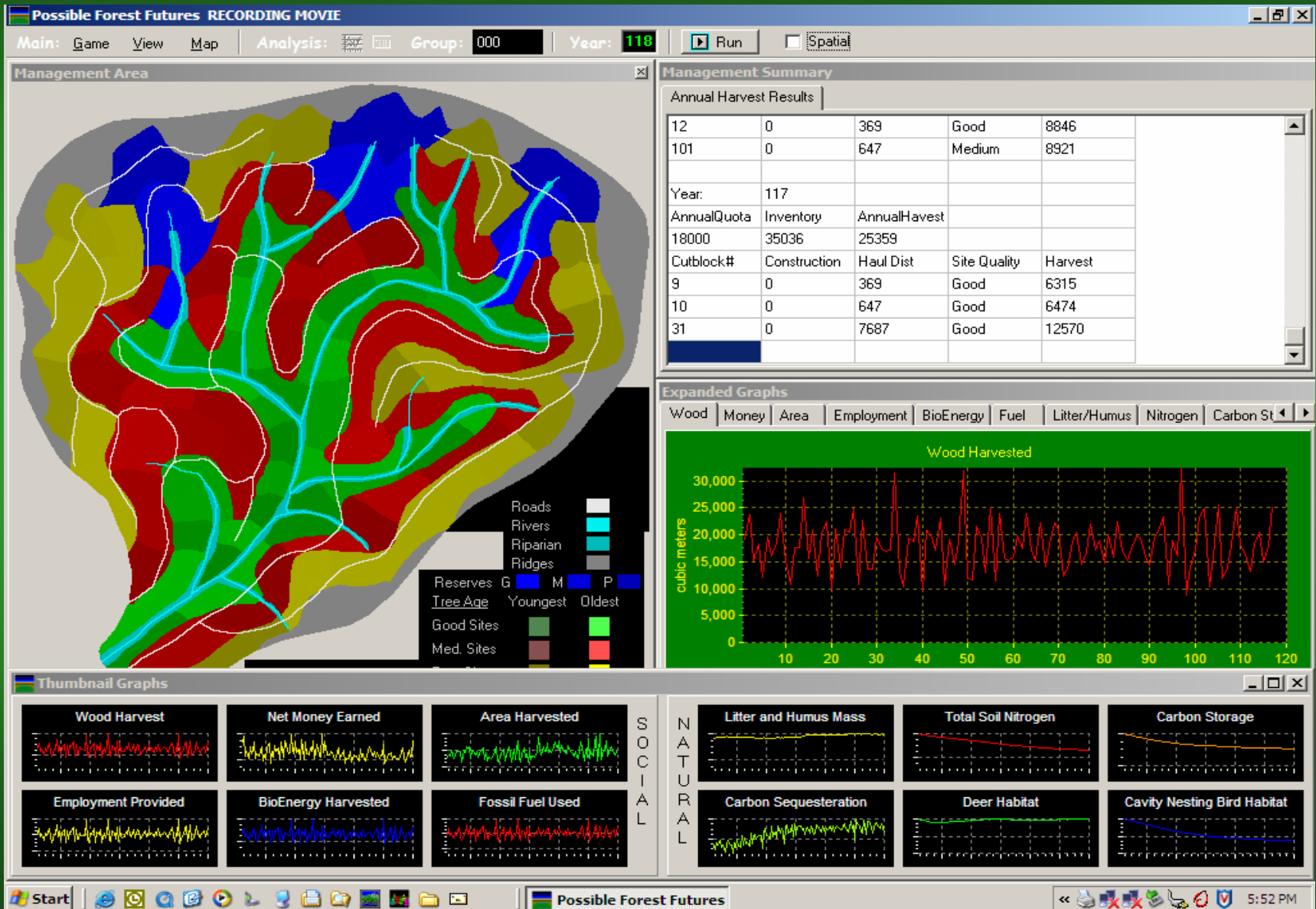


Ecosystem Management and Bioenergy Scenario Analysis Tools

- Appropriate complexity level
- Key processes
- Various spatial scales
- Key values to be represented

Timber, NTFPs, employment, economics, carbon budget, soil fertility, sustainability, biodiversity values, aesthetics, water, fish values, wildlife habitat values, etc.....

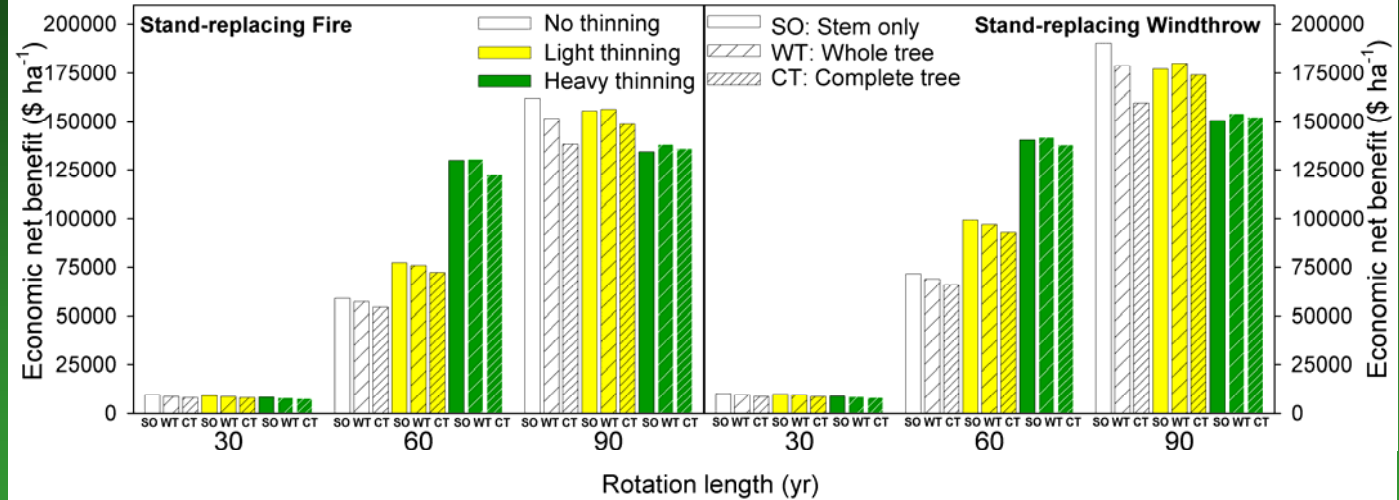
POSSIBLE FOREST FUTURES



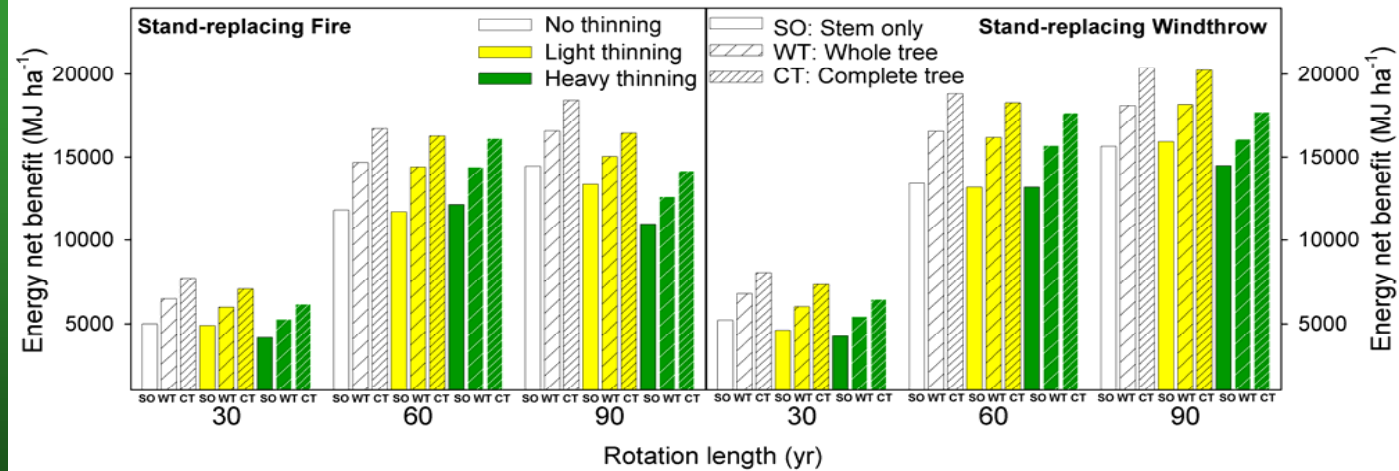
Example of FORECAST Analysis of Sustainability

- Data for Douglas-fir plantation, Shawnigan Lake, southern Vancouver Island
- 180 year simulation; two disturbance histories, three thinning levels, three utilization levels
- Output for stand-level economics, energy, shrub biomass, tree biomass, soil humus and nitrogen, slash biomass, visualization

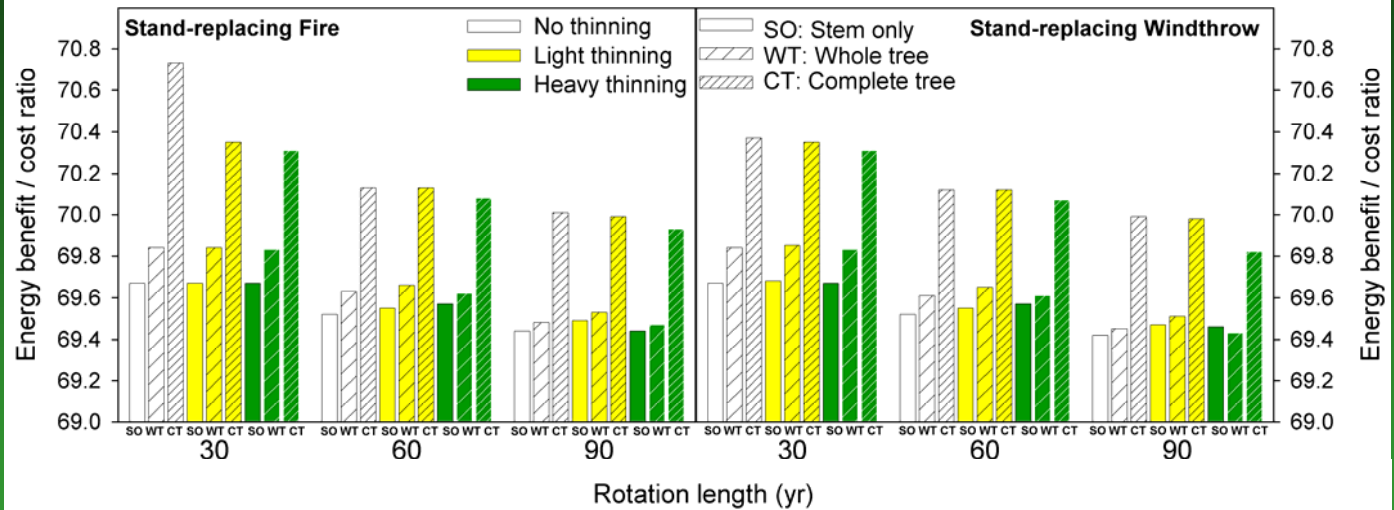
Economic net benefit



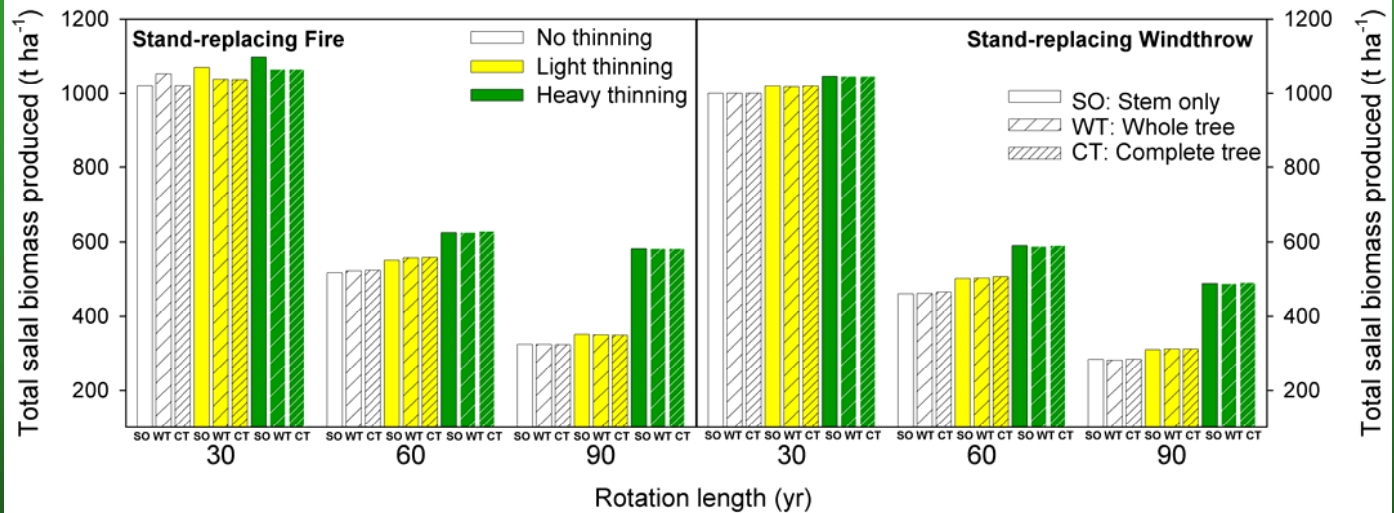
Energy net benefit



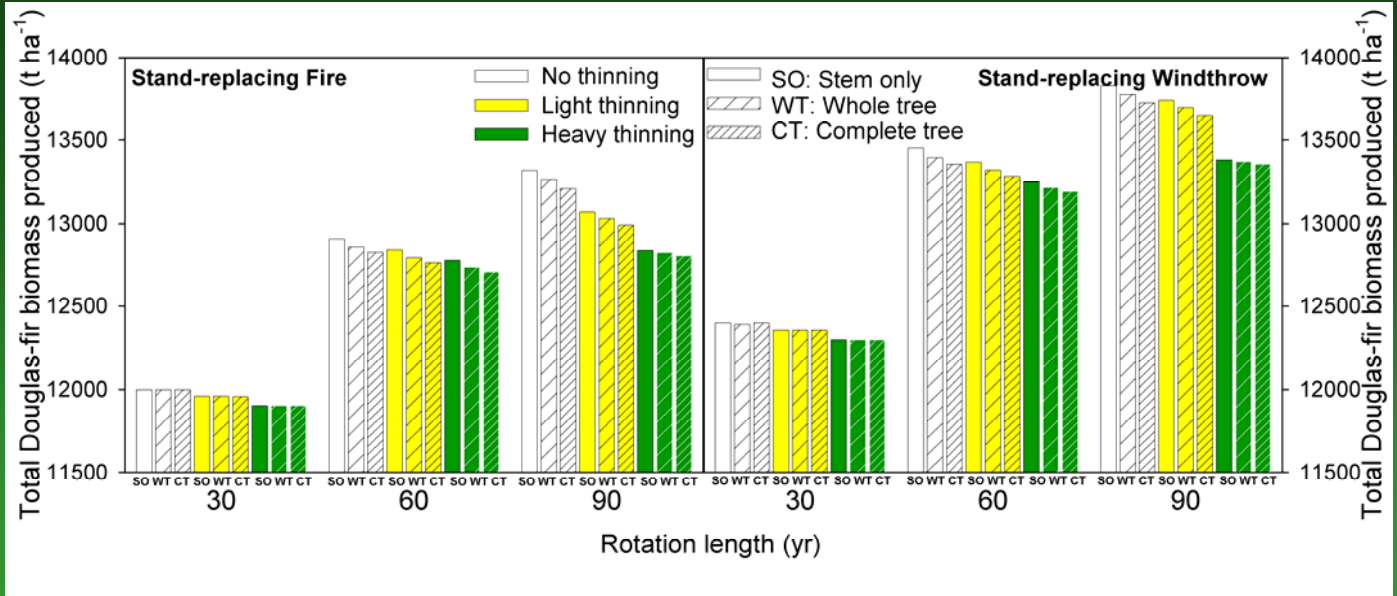
Energy
b/c ratio



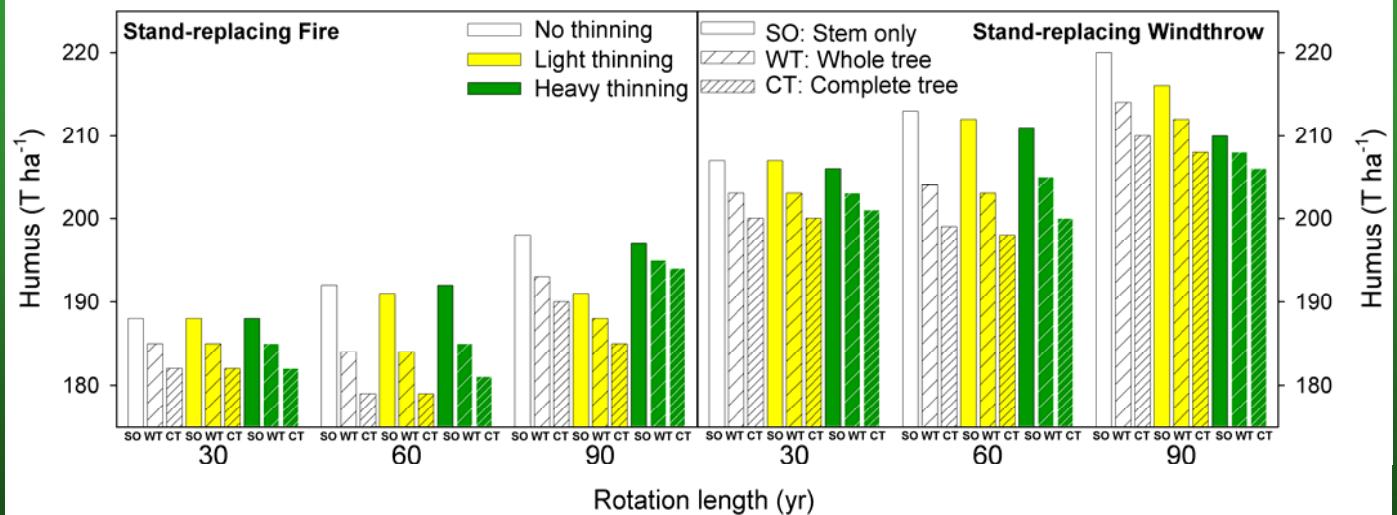
Shrub NTFP



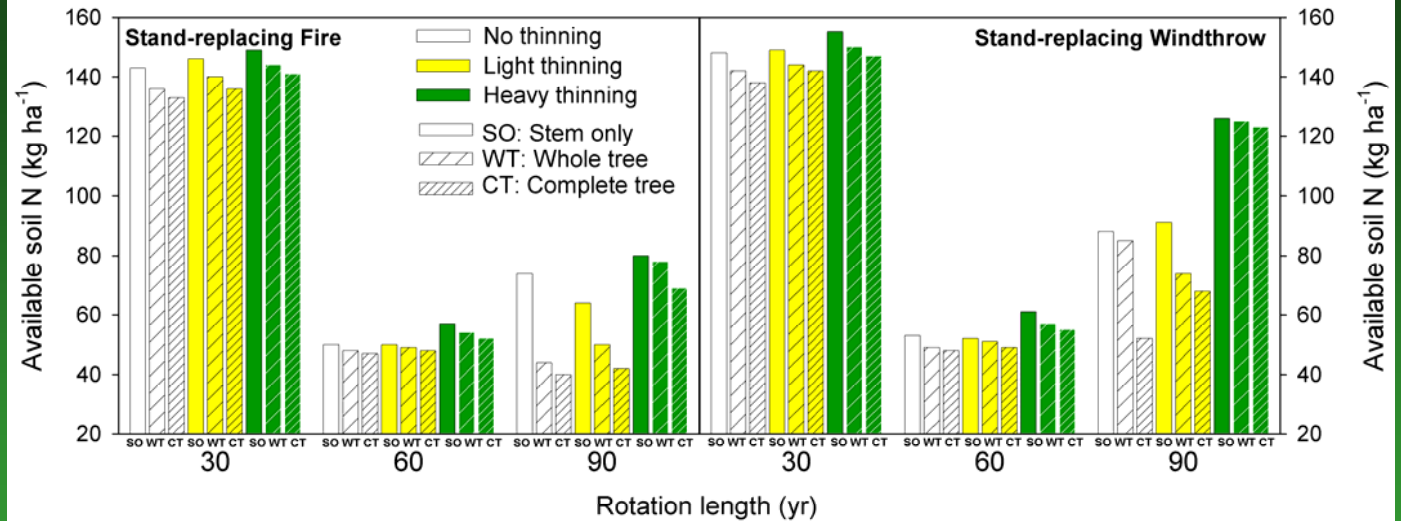
Douglas-fir biomass



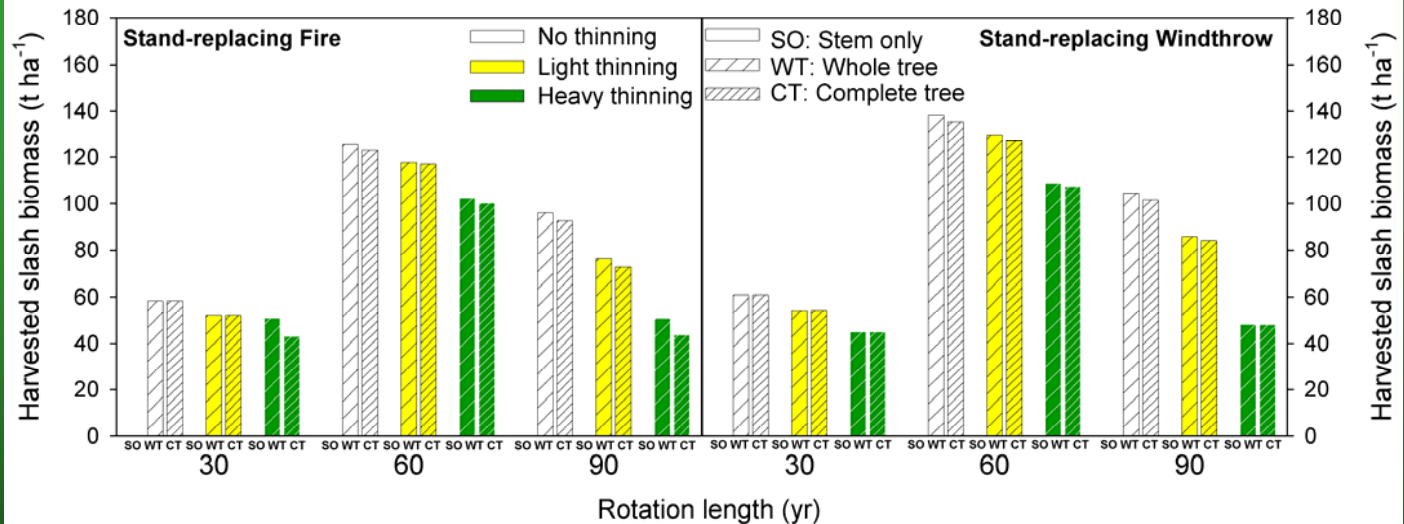
Humus



Available soil nitrogen

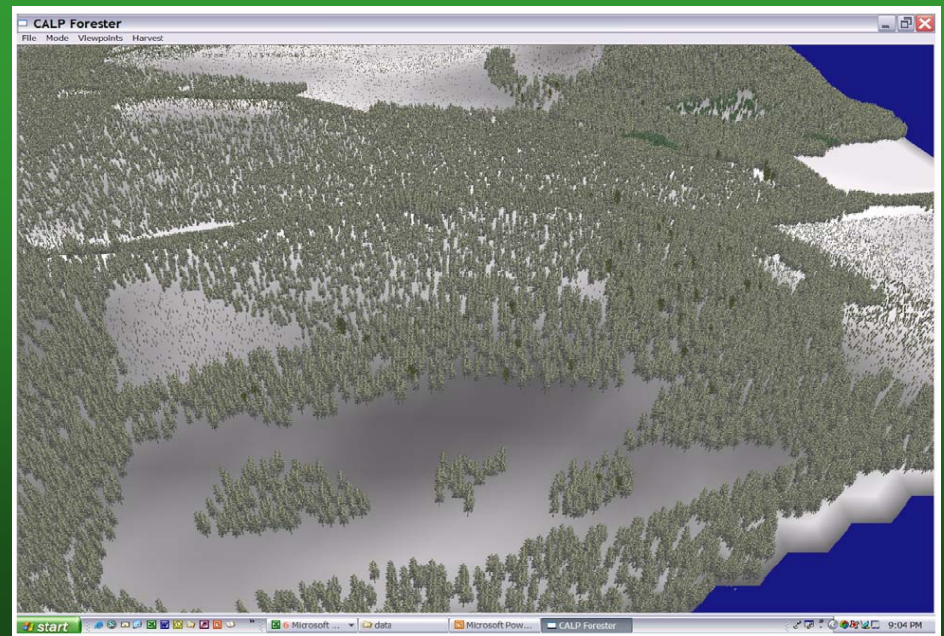


Biomass of roadside slash

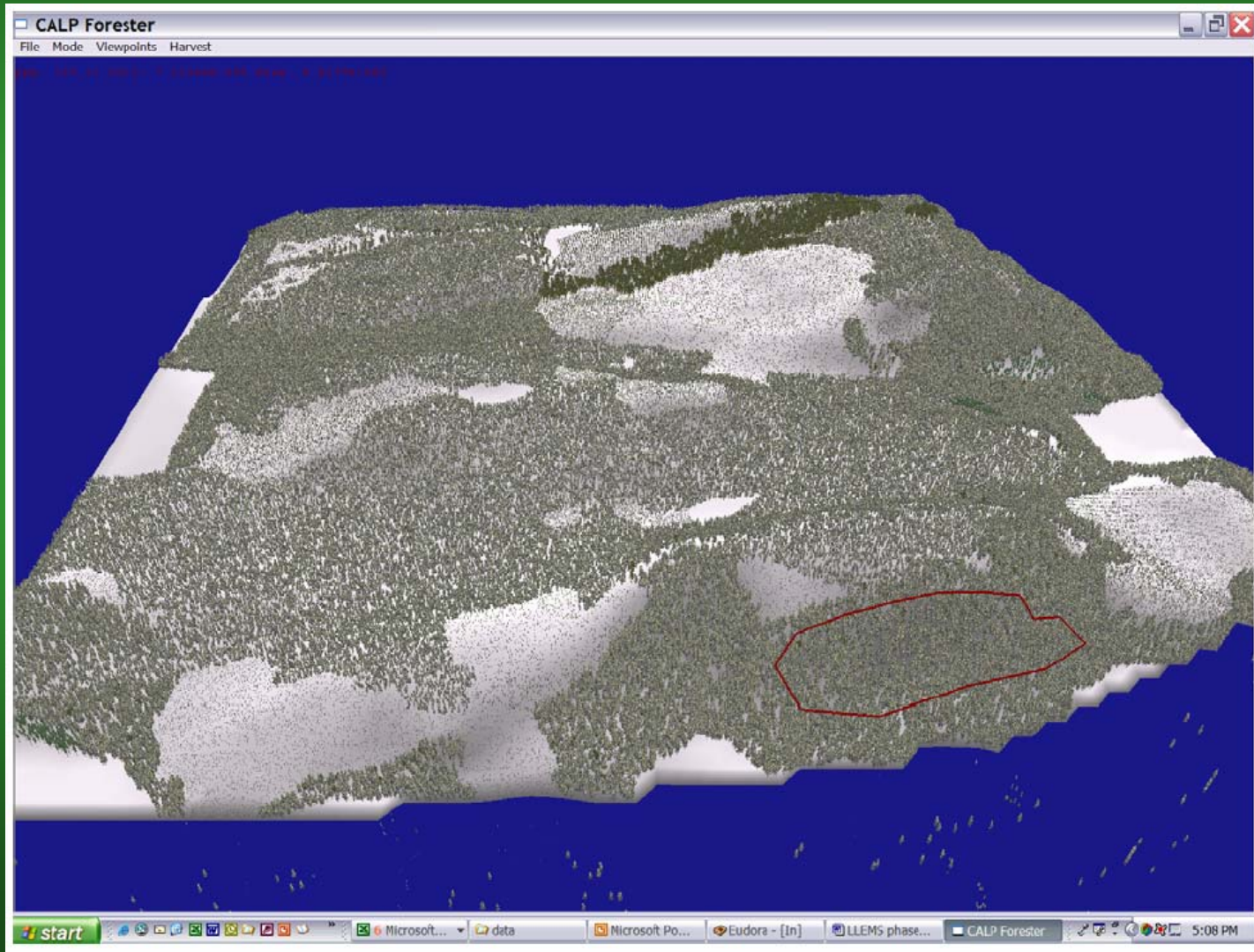


Other Values provide by FORECAST:

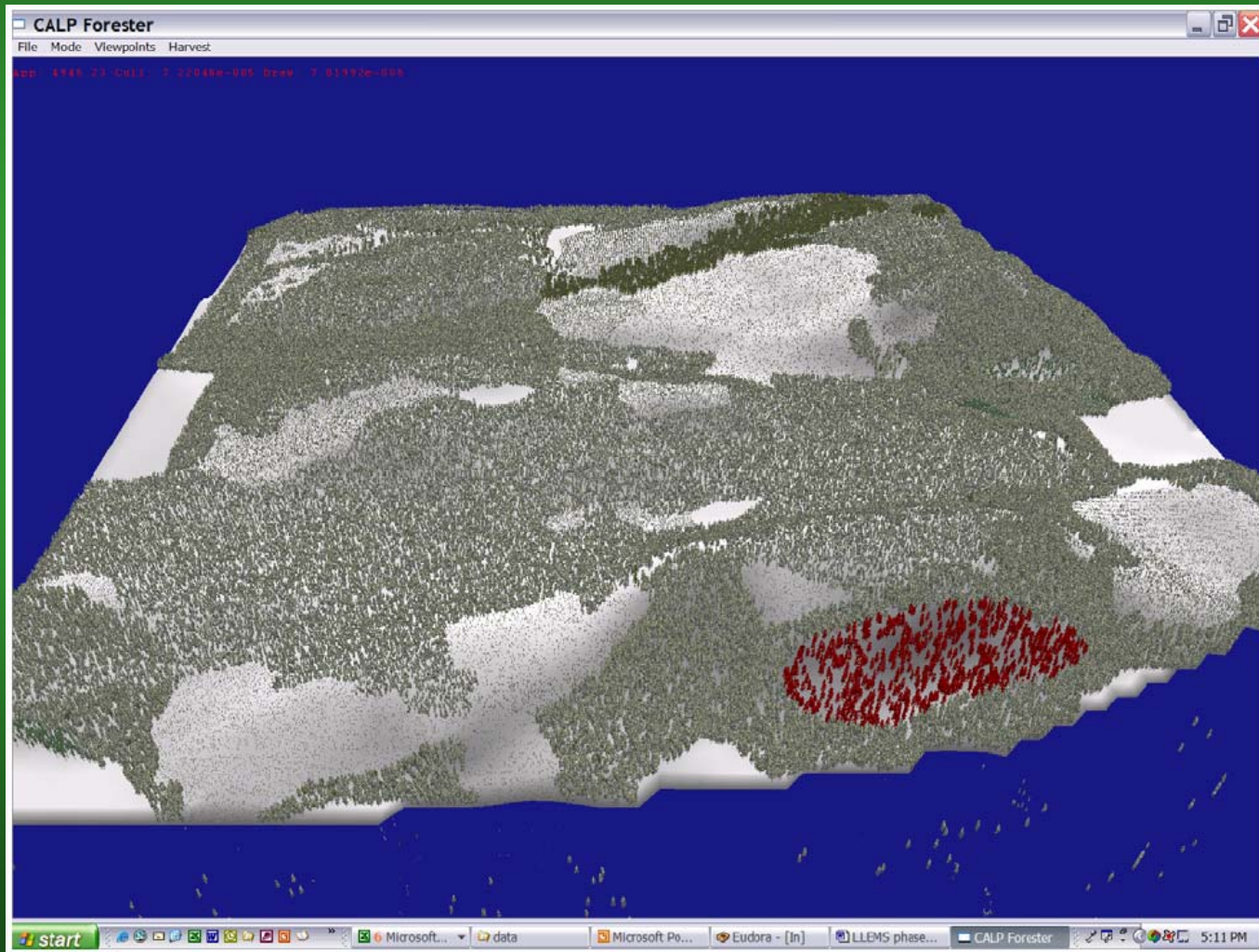
- Wildlife habitat values – depends on the species
- Employment
- Aesthetics:



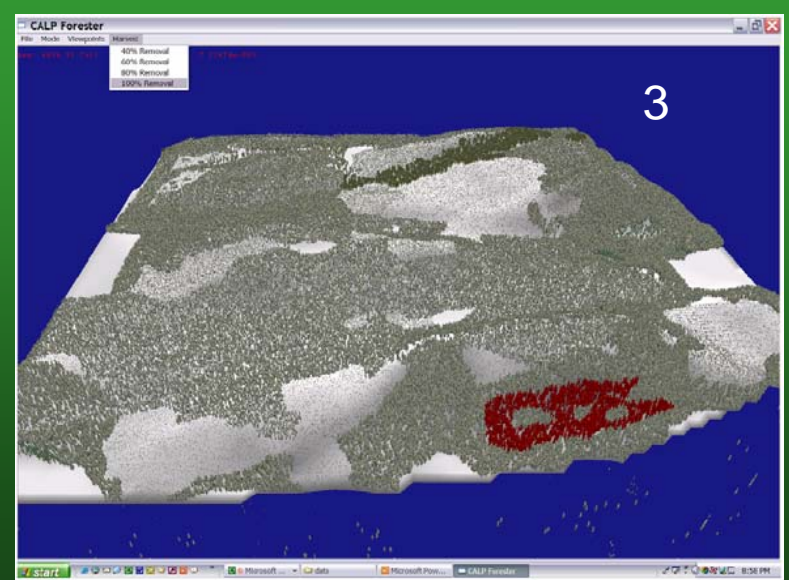
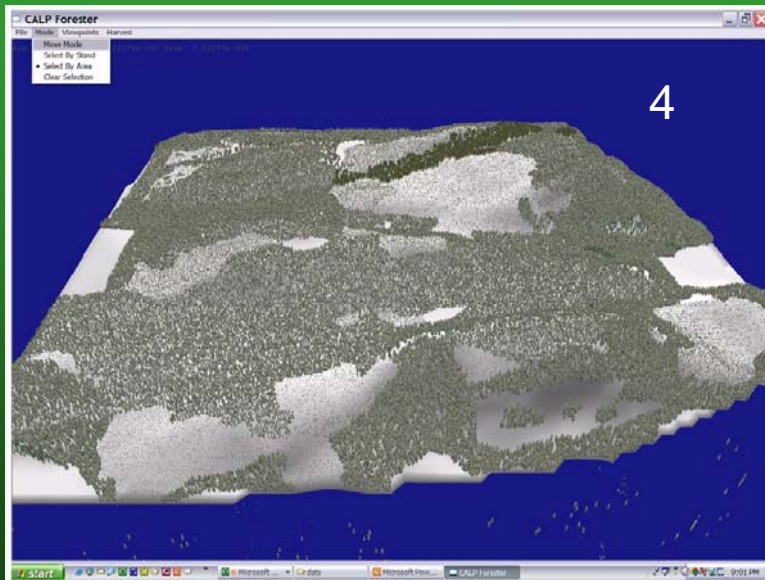
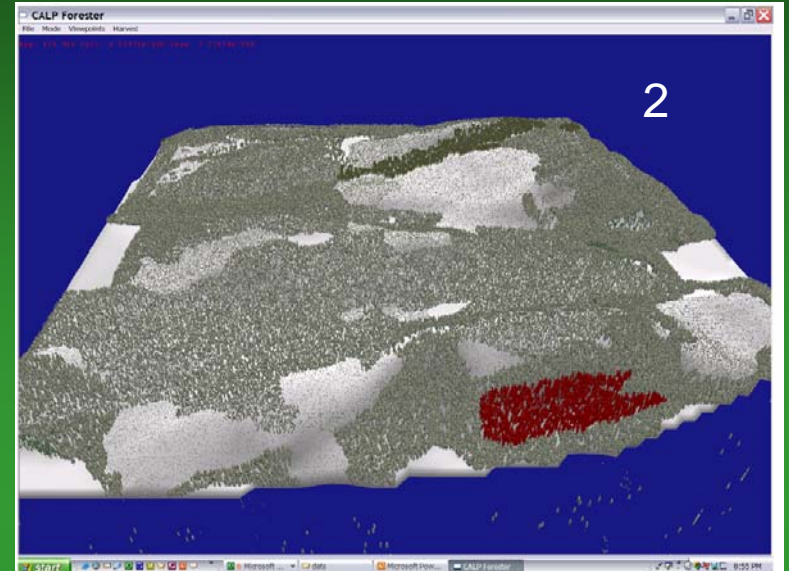
CALP FORESTER visualization output using a mouse to select cutblock boundary for dispersed retention



CALP FORESTER visualization output showing 20% dispersed retention



Defining grouped retention with a mouse



Conclusions

- Values and environmental services desired from forests have always been changing
- Bioenergy was, and once again is, an important forest product
- The increasingly complex set of values desired requires ecosystem management
- The complexity of ecosystem management requires the use of ecosystem-level value tradeoff and scenario analysis tools

