Scenario Modeling Informs Spruce Restoration in West Virginia

Melissa Thomas-Van Gundy
USDA Forest Service Northern Research Station
Parsons, WV

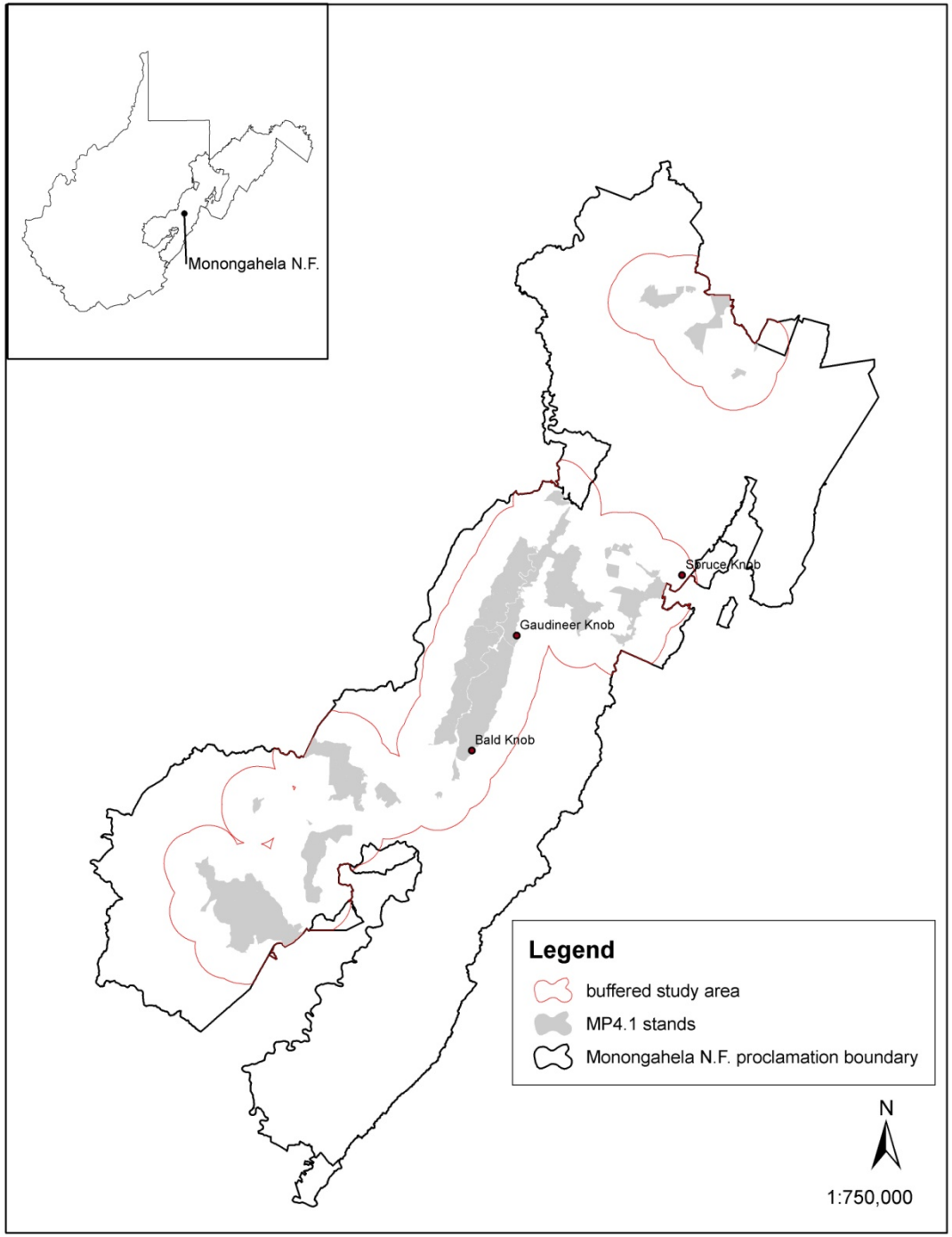
Brian Sturtevant
USDA Forest Service Northern Research Station
Rhinelander, WI

Address Restoration Questions With a Landscape-Scale Model

- *Problem statement*
- *Study area*
- *LANDIS-II model methods*
- *Results*
- *Discussion*

Problem Statement

- *Goals for restoration of red spruce-dominated forests*
- *Desire to protect but also improve habitat for TE animals*
- *Will active restoration reach the goals sooner than passive?*
- *Do constraints still allow for active management?*
- *Can the restoration actions be implemented and for how long?*



Study Area

Monongahela National Forest

- ~ 62,000 ha in MP4.1
- Current spruce-dominated forest – 20,000 ha
- Estimated previous - 69,000 to 174,000 ha

Forest Plan Restoration Goals

- *60-80% area in late seral stage (120+ years old)*
- *3-8% of area in early seral (1-19 years old)*
- *Uneven-aged*
- *Increase in area in red spruce*
- *Increase suitability for TE species*
- *Connect patches*

Forest Plan Restoration Goals

- *At the time of Plan revision (2006) federally listed species included*
  - *Northern flying squirrel (Glaucomys sabrinus fuscus)*
  - *Cheat Mountain salamander (Plethodon nettingi)*

NFS Habitat and Listing History

- *Nocturnal*
- *Eats fungus associated with red spruce*
- *Nests in tree cavities*
- *Listing history*
  - *Listed 1985*
  - *De-listed 2008*
  - *Re-listed 2011*
  - *Re-de-listed 2013*

Forest Plan Objectives, Standards, and Guidelines

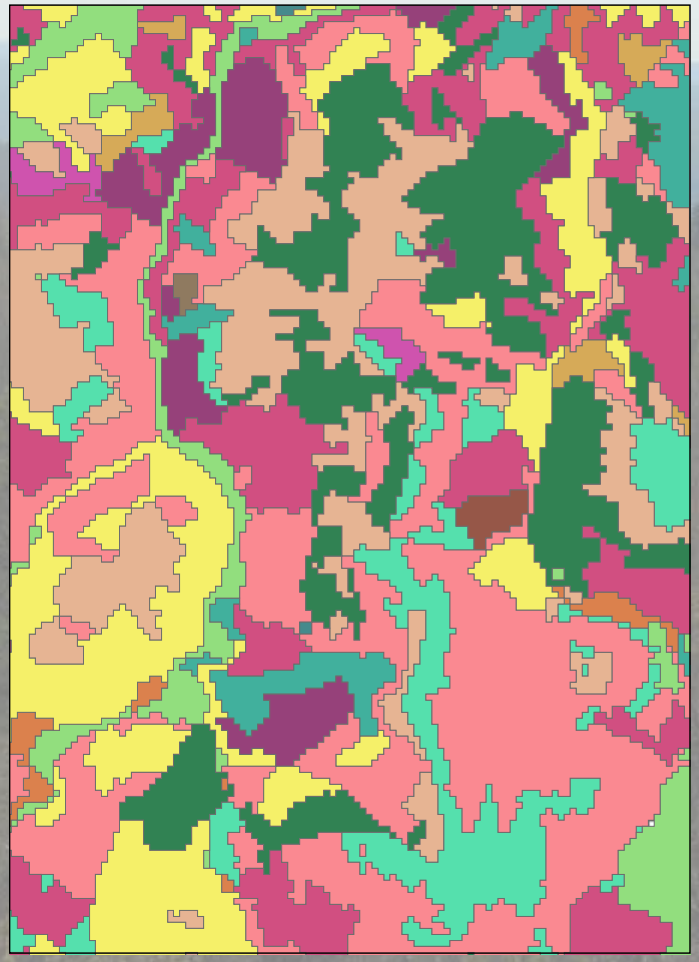
Spruce and Spruce-Hardwood Ecosystem Management

- *1,000-5,000 acres active restoration over 10 years*
- *No management in areas 80+ years old, with 30%+ red spruce in overstory*
- *Group selection preferred silvicultural system*

LANDIS-II Model Overview

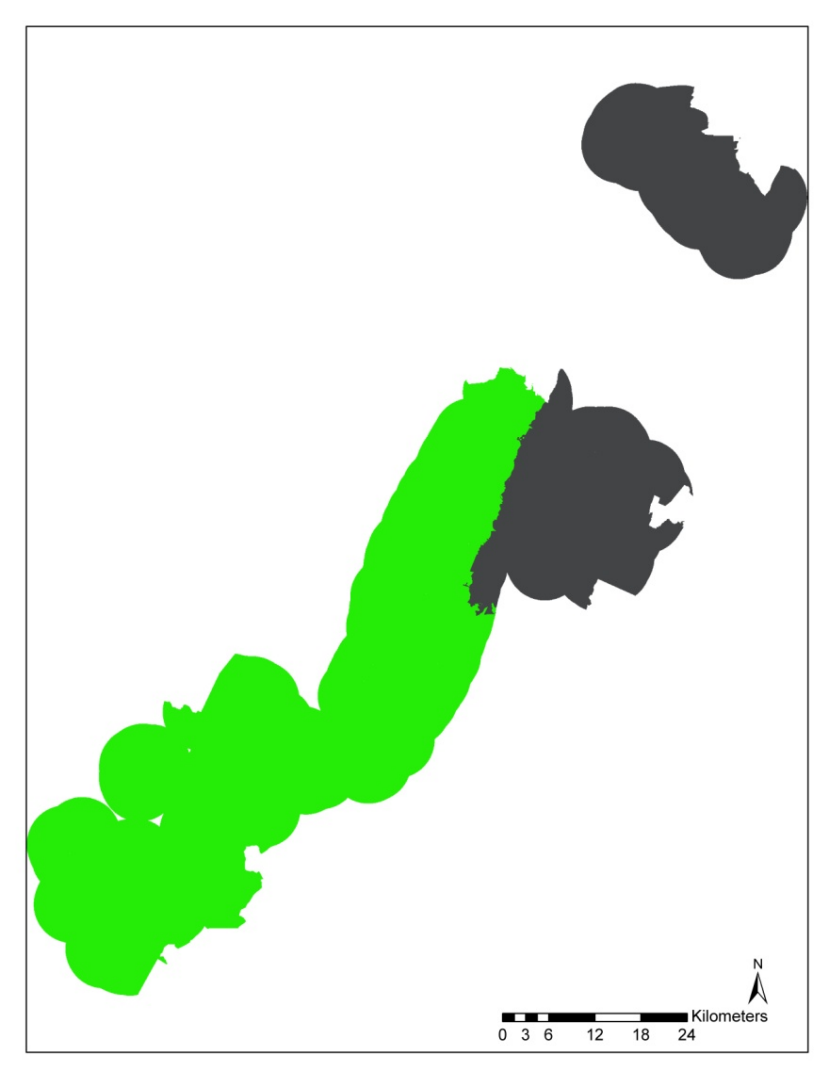
- *Landscape scale does not model individual stems*
- *Uses species-age cohorts*
- *Life history attributes drive model*
- *Spatially dynamic*
- *Simplification through homogeneity*
  - *Sites – light homogeneous*
  - *Ecoregions – climate, soils homogeneous*
- *User adds complexity (or not)*

LANDIS-II Model Inputs



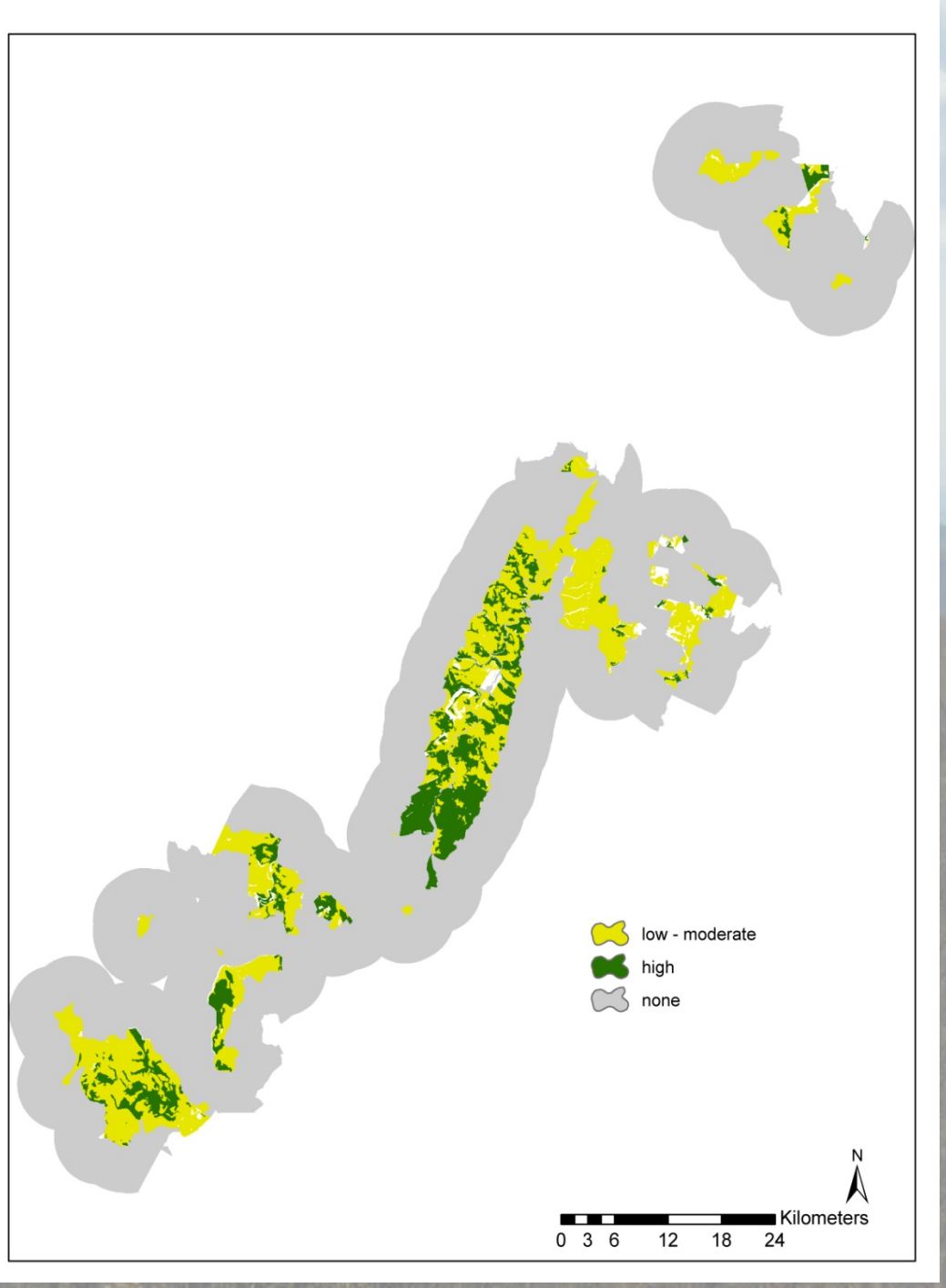
- *Initial communities (42)*
  - *Stand data summarized by species and age*
  - *Life history attributes by species*
    - *Longevity*
    - *Age of maturity*
    - *Shade tolerance*
    - *Fire tolerance*
    - *Effective seeding distance*
    - *Maximum seedling distance*
    - *Vegetative reproduction probability*
    - *Minimum age of vegetative reproduction*

LANDIS-II Model Inputs



- *Ecological subsections (2)*
  - *Probability of species establishment*
  - *Climate & soil data*
- *Biomass succession*
  - *Seeding algorithms*
  - *Minimum relative biomass by shade class*
  - *Mortality curve shape*
  - *Maximum annual net primary productivity*
  - *Maximum biomass*

NFS PROBABILITY OF POTENTIAL HABITAT



Menzel and others 2006

LANDIS-II Model Scenarios

Scenarios differ by the way NFS habitat protected

Applied by management area (probability of NFS habitat)

100 years

- *NoRestrictions*
  - *All areas available regardless of NFS habitat potential*
  - *Up to 3% of area harvested per decade*
  - *to be eligible*
    - *10%+ of cells with red spruce*
    - *Stand age 50 – 120 years*
    - *10 years between stand entries*
- *ProtectHabitat*
  - *Harvest allowed only in areas low-moderate potential for NFS*
  - *Up to 5% of area harvested per decade*
  - *Same stand eligibility rules as No Restrictions*

LANDIS-II Model Scenarios

- *ProtectSpruce*
  - *All areas available regardless of potential NFS habitat*
  - *Up to 3% of area harvested per decade*
  - *No harvest in stands with 31-100% of cells with red spruce 80-400 years old*
    - *Stand age 50 – 120 years*
    - *10 years between stand entries*
- *NoHarvest*
  - *Biomass succession*

LANDIS-II Model Harvest

- *1-ha patch openings*
- *All but youngest cohorts removed within patch*
- *No red spruce removed*
- *Patch openings 30% or less of stand area*

Same harvest applied in all 3 scenarios

No wind or fire events included in any scenario

LANDIS-II Model Outputs

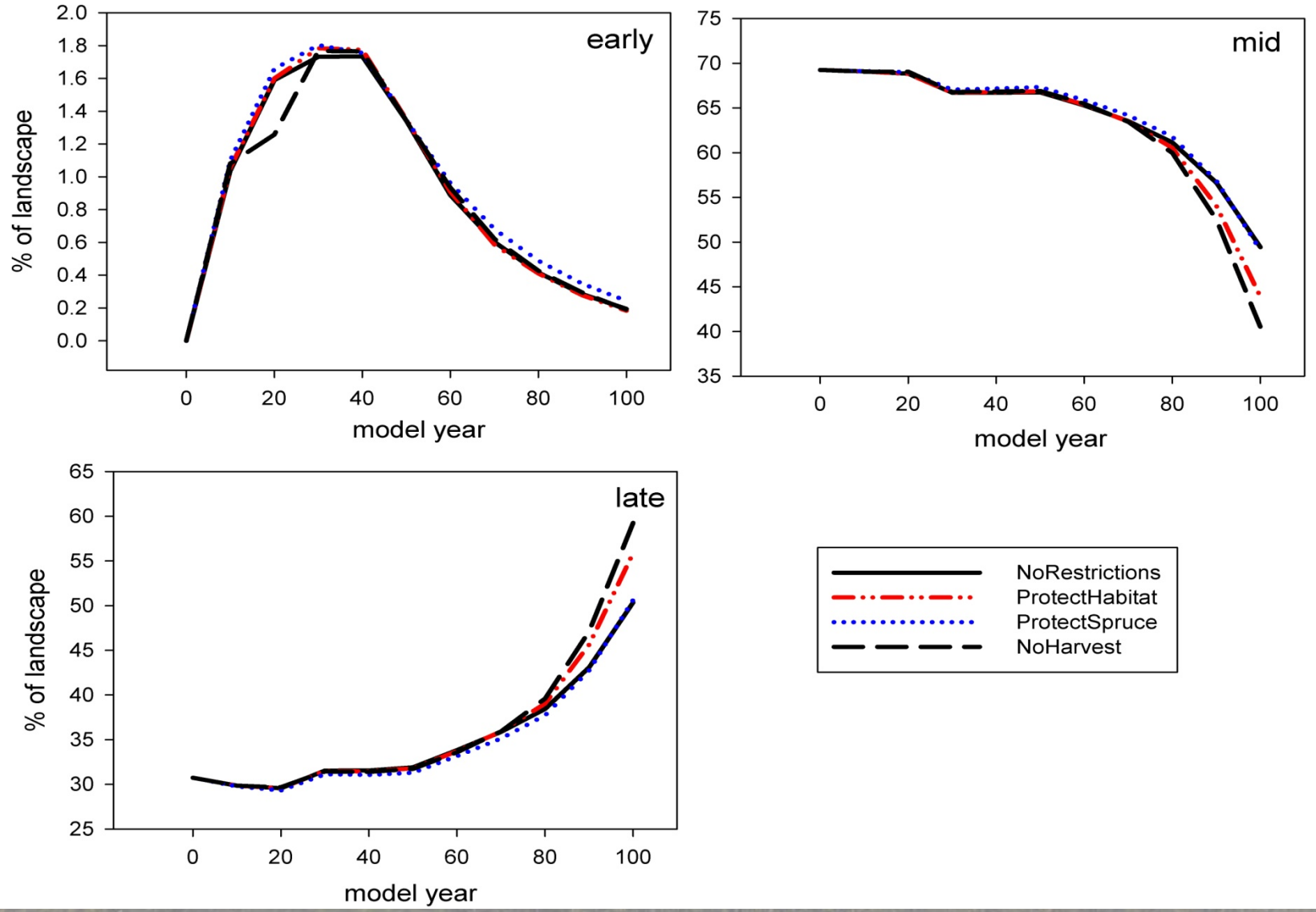
- *Re-class extension used to create forest types*
- *Average age of cell by species*
- *Biomass and age of selected species*

3 runs of all scenarios averaged

Outputs given every 10 years

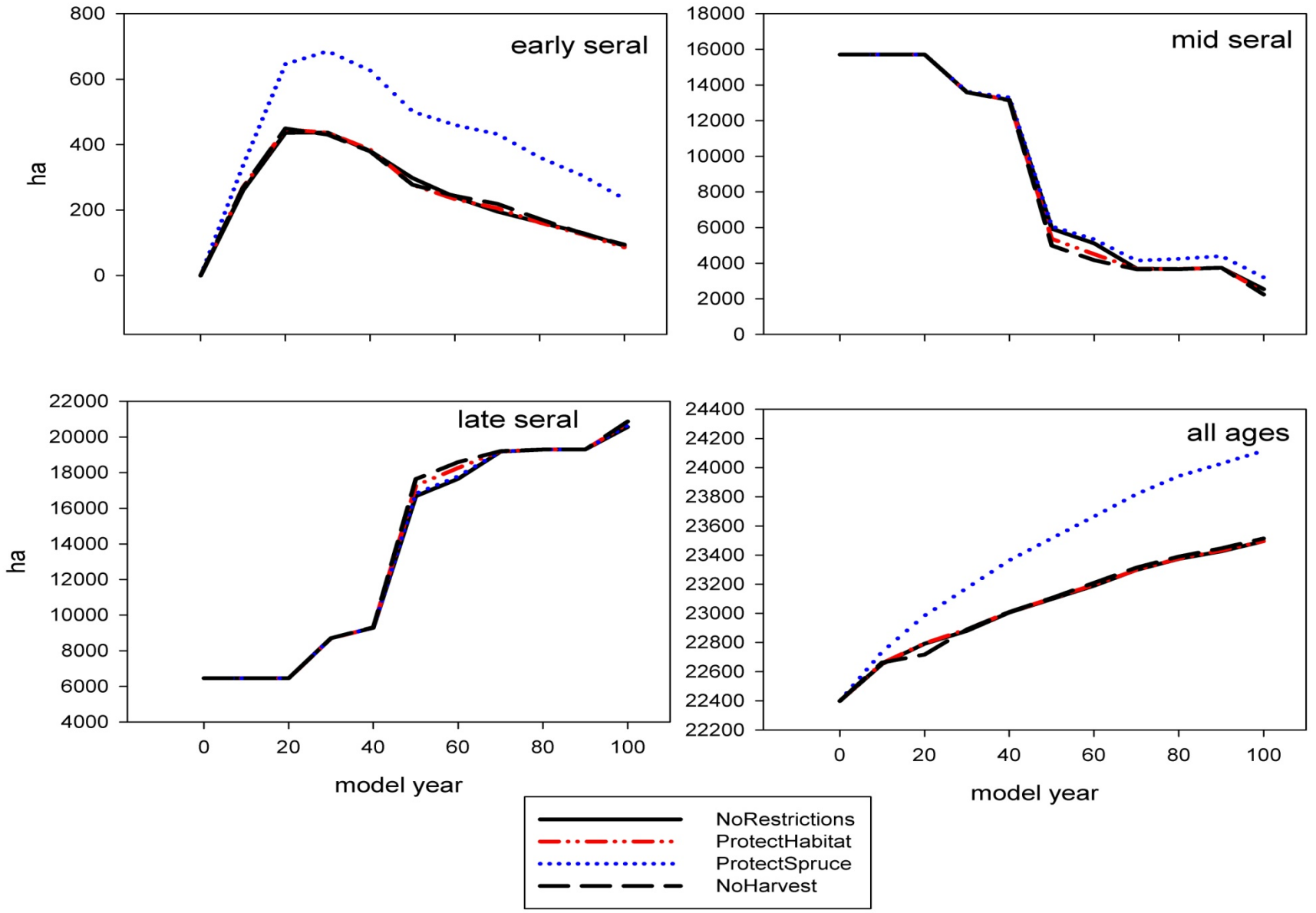
Results

% of landscape in red spruce and red spruce-northern hardwood forest types by seral stage



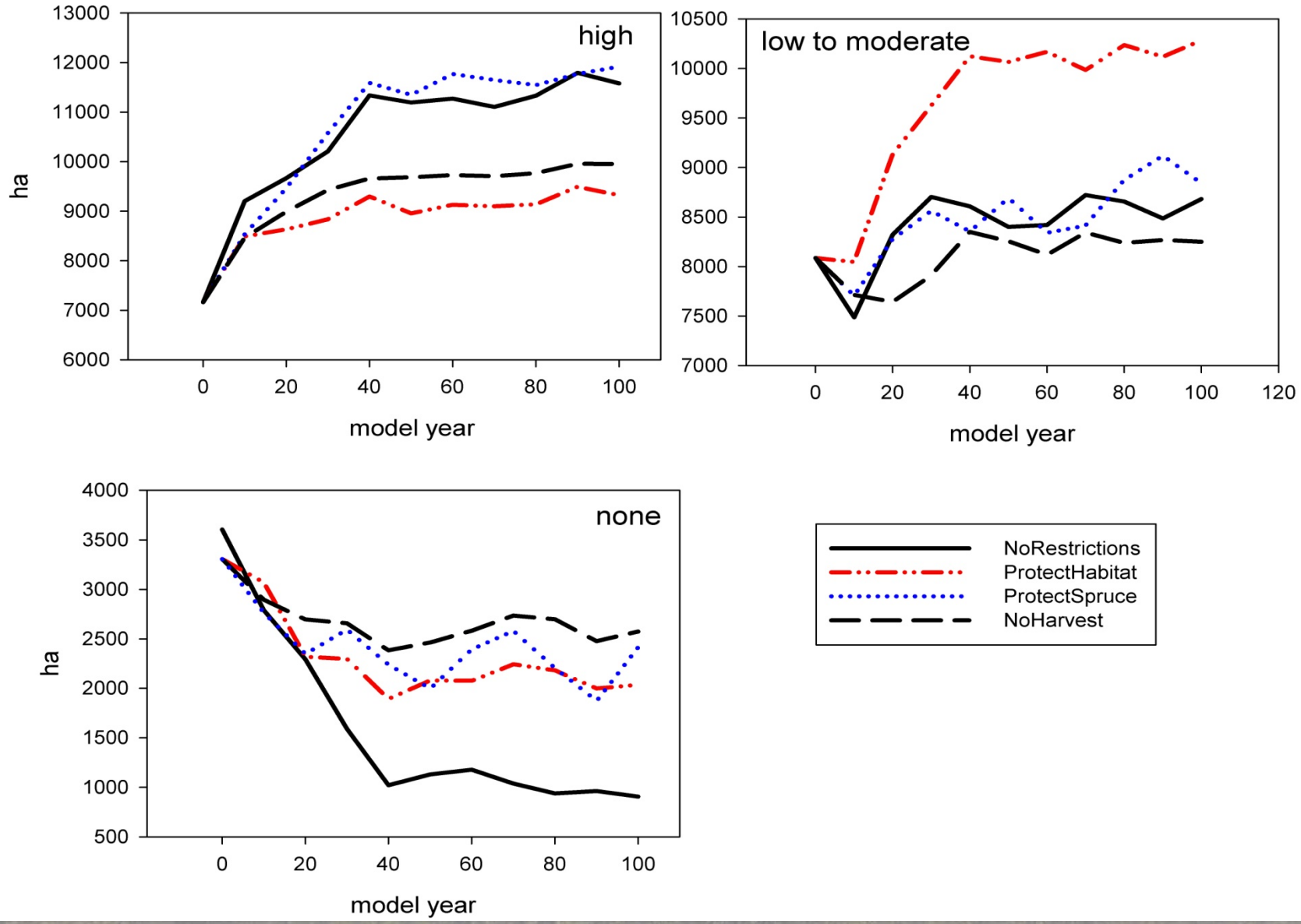
Results

Area in red spruce only by seral stage and total



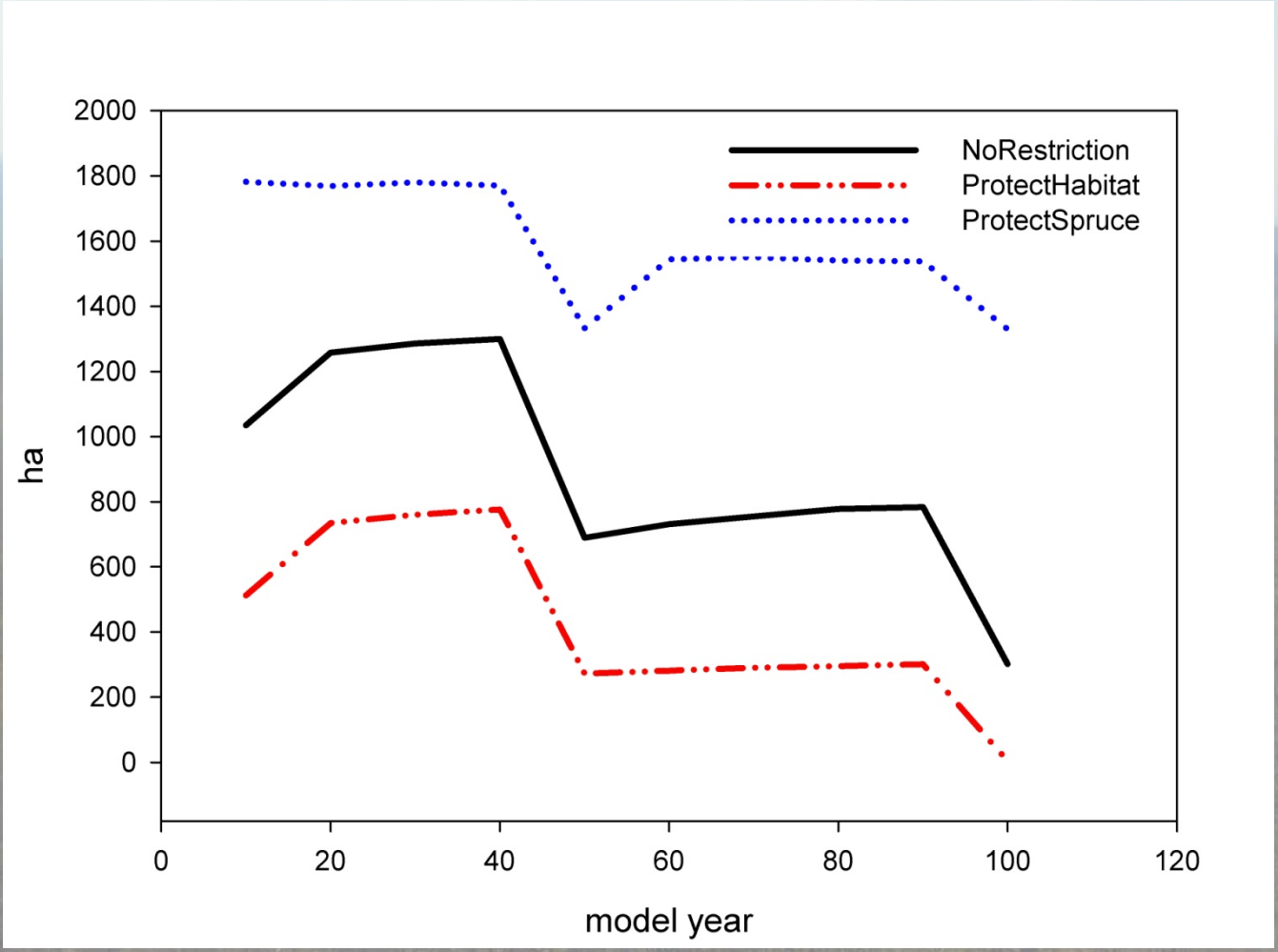
Results

Area with red spruce present (any age) by NFS habitat class



Results

Area harvested per decade



Results

- *ProtectSpruce - more area in red spruce than with ProtectHabitat*
  - *Difference apparent early in model*
  - *At 100 years – difference is ~900ha*
  - *More area in early seral red spruce ~200 ha at peak*
- *ProtectHabitat - more red spruce in areas of low to moderate NFS probability*

  ~1,600 ha more greatest difference

- *Reclassifying by forest type, shows little difference between alternatives*
- *ProtectSpruce alternative highest harvest (still within objectives)*
- *ProtectHabitat may be out of available area to harvest*

Results

No model is "the answer"

- *Did we meet the goals?*
  - *Goals for % by seral stage not met except late stage with NoHarvest*
- *Will active restoration reach the goals sooner than passive?*
  - *Yes for total area in red spruce*
  - *Yes for early successional*
- *Do constraints still allow for active management?*
  - *Yes, able to find areas to harvest and increase red spruce*
- *Can the restoration actions be implemented, and for how long?*
  - *Maybe, patch cuts difficult operationally*
  - *Protecting habitat may constrain over long term*

Discussion

- *Age of uneven-aged forests?*
  - *Do the original goals make sense?*
- *100 years isn't long for red spruce-dominated forests*
- *How do we know when something is restored?*
- *No climate change in this model*
- *Other silvicultural options to try*

Working with LANDIS-II

- *Define your questions up-front*
- *Many inputs*
- *Reams of output*
- *Great support*
- *But, work with someone who has used this before*