# Understanding landscape-level feedbacks between fire and forest management in British Columbia's Okanagan Region under historical and future climate scenarios

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- Large and severe wildfires lead to highly significant carbon emissions, now often overtaking emission reductions from all other sectors
- We must address this wildfire crisis if we hope to mitigate climate change effects in BC
- This will require increasing the resilience of our forest to fire, climate change, forest insects and pathogens
- But how can we foster resiliency, what are the trade offs?

- Historical fire regimes created landscape level resilience
- Accumulation and continuity of fuels after 100 years of fire suppression make them vulnerable to severe fire behavior
- Fuel treatments proven to help at the stand-level, but landscape level impacts remain poorly understood


# RESEARCH OBJECTIVES: UNDERSTANDING LANDSCAPE RESILIENCE


1) **Historical Landscapes**: what created resilience in the past?

2) **Aspen**: did hardwoods play a role in historical resilience, and could they play a role in the future?

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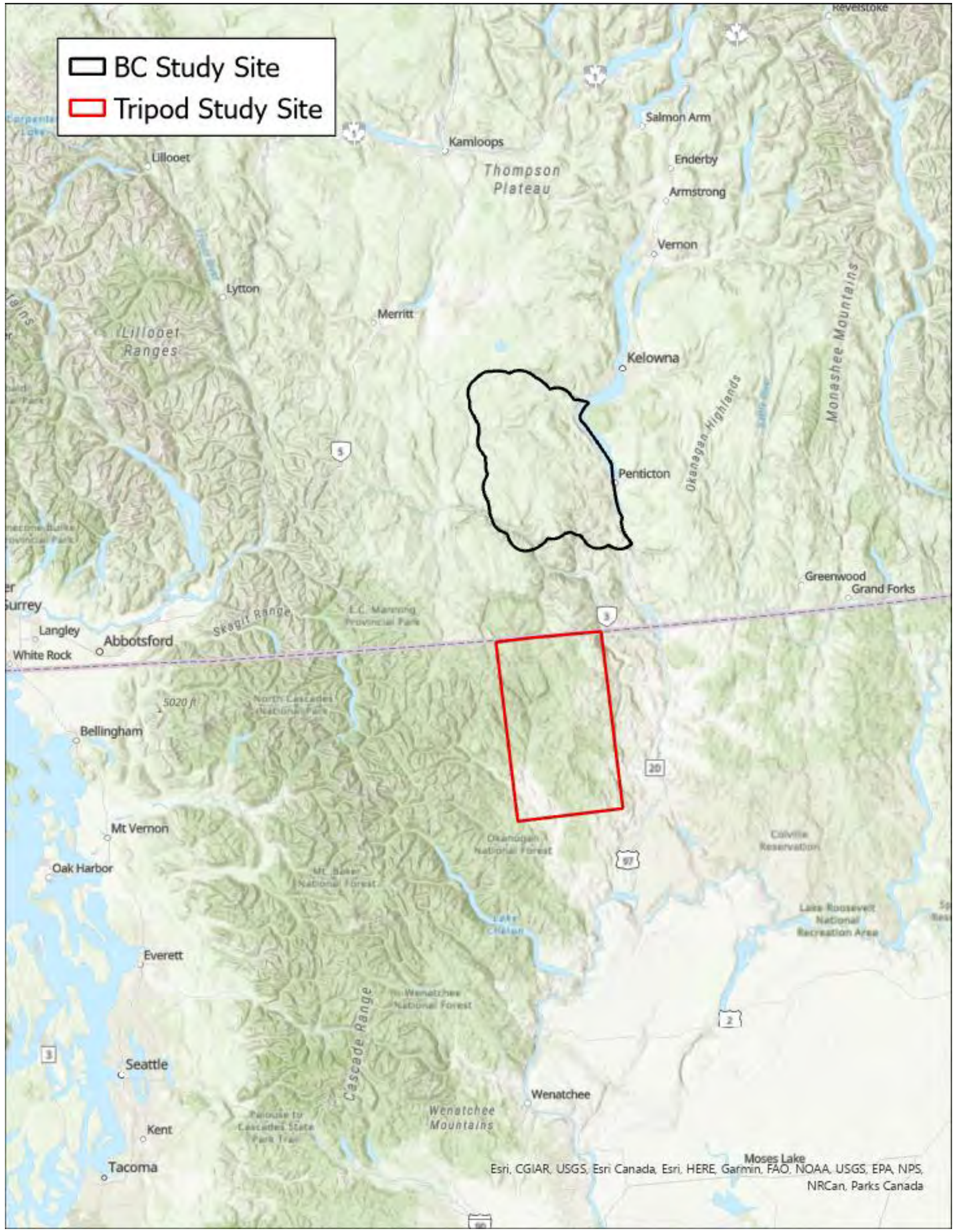
4) **Forest Management**: how can we use management tools to create these resilient characteristics?

# REBURN

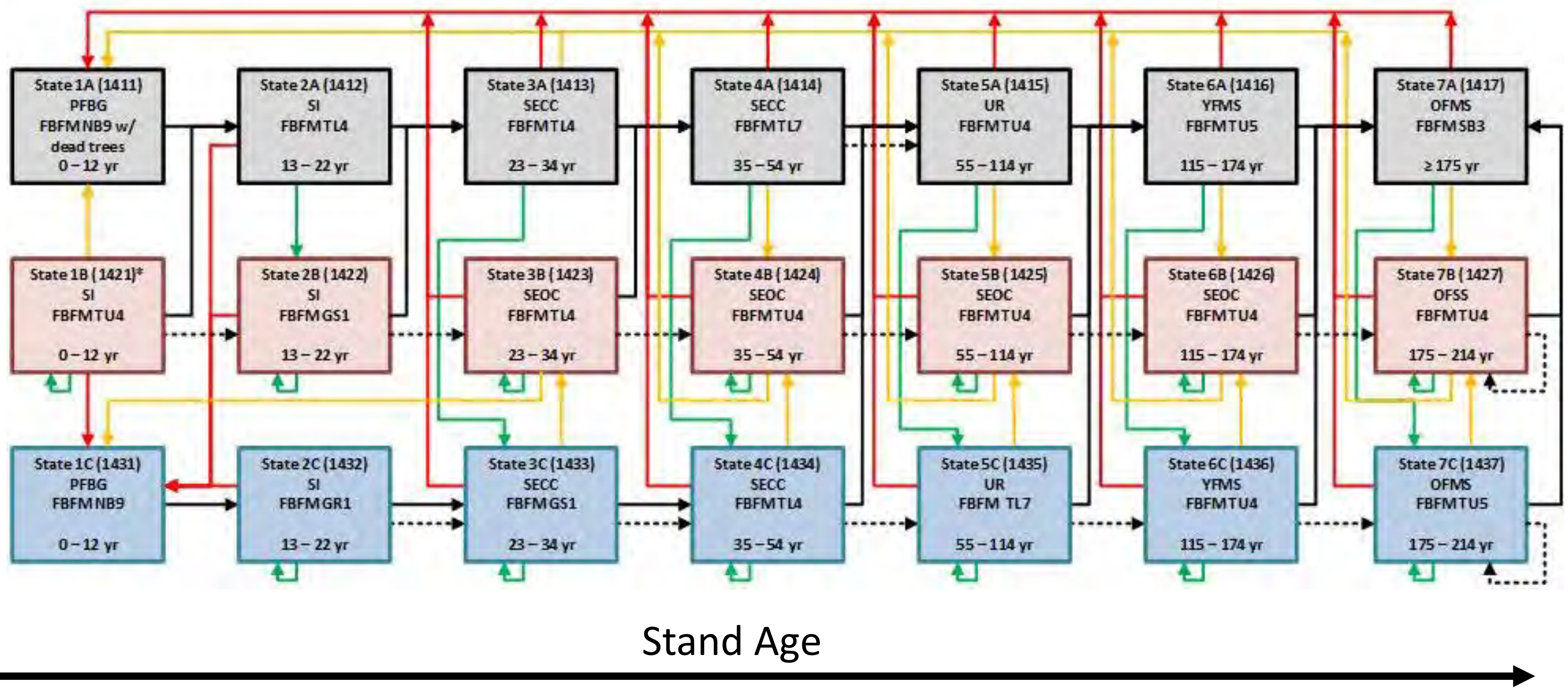
- Simulates the feedbacks between wildfire dynamics and forest and fuel succession across the landscape
- Allows us to simulate historical landscape dynamics and understand the characteristics of resilience that emerge from such dynamics
- Gives us important clues as to the nature and structure of resilience properties and feedbacks
- That knowledge allows us to tune these properties in a forward looking 21st century climate

Composed of:

1. State-Transition Models
2. Fire Simulation Model



# STATE AND TRANSITION MODELS



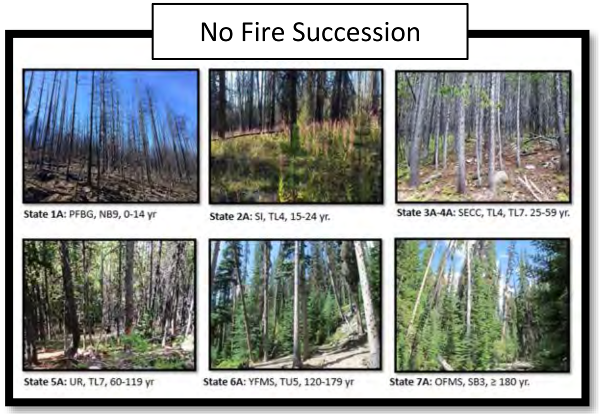

**Transition Types**

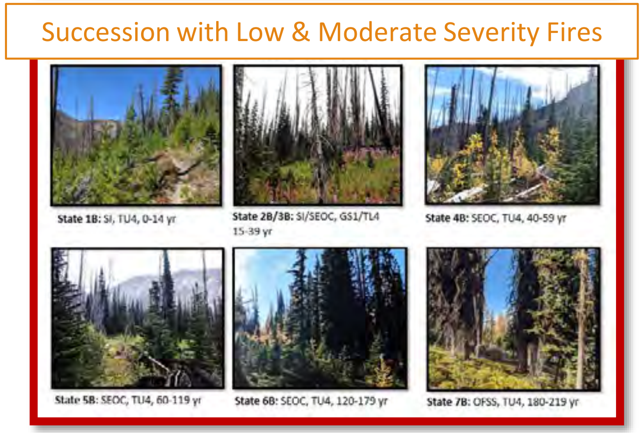
| | |
|---|---|
| Non-fire succession | solid black arrow |
| Burned state succession | dotted black arrow |
| Low severity fire | green arrow |
| Moderate severity fire | yellow arrow |
| High severity fire | red arrow |

*Time-zero state for non-fire lethal transition

PFBG = Post Fire Bare Ground
SI = Stand Initiation
SEOC = Stem Exclusion Open Canopy
SECC = Stem Exclusion Closed Canopy

UR = Understory Re initiation
YFMS = Young Forest Multi Story
OFMS = Old Forest Multi Story
OFSS = Old Forest Single Story

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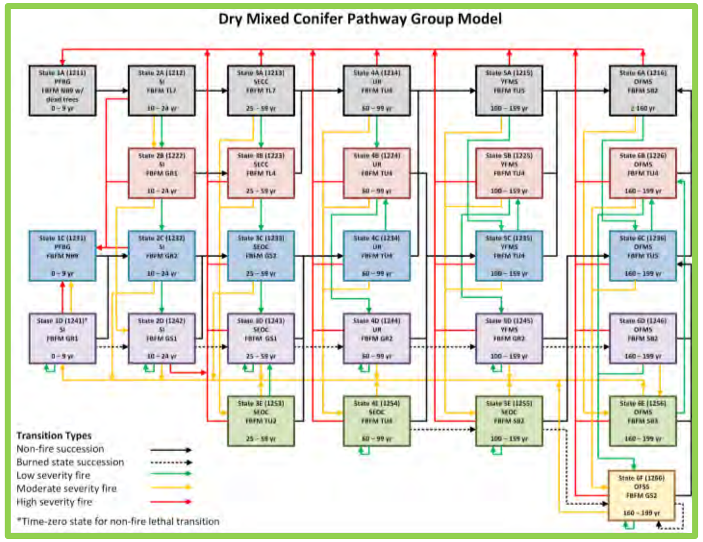


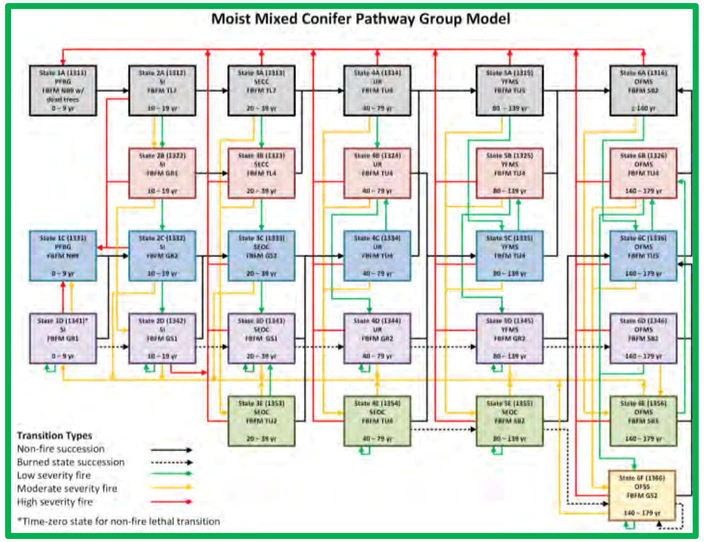


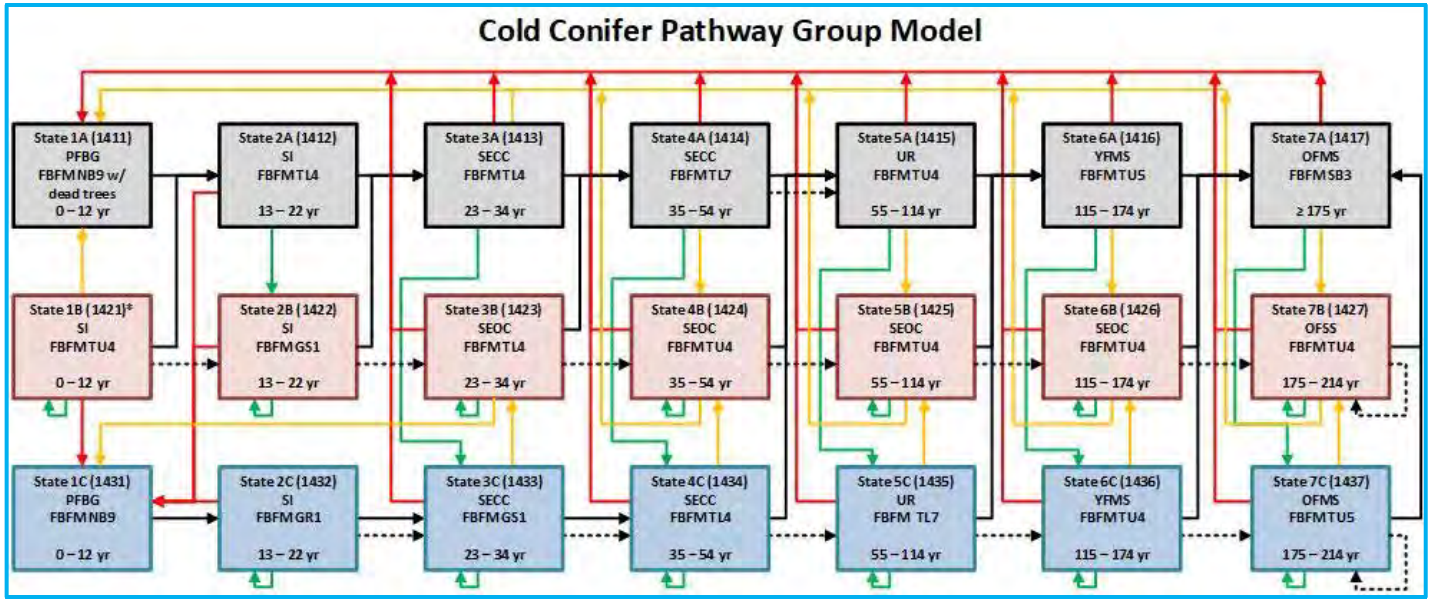


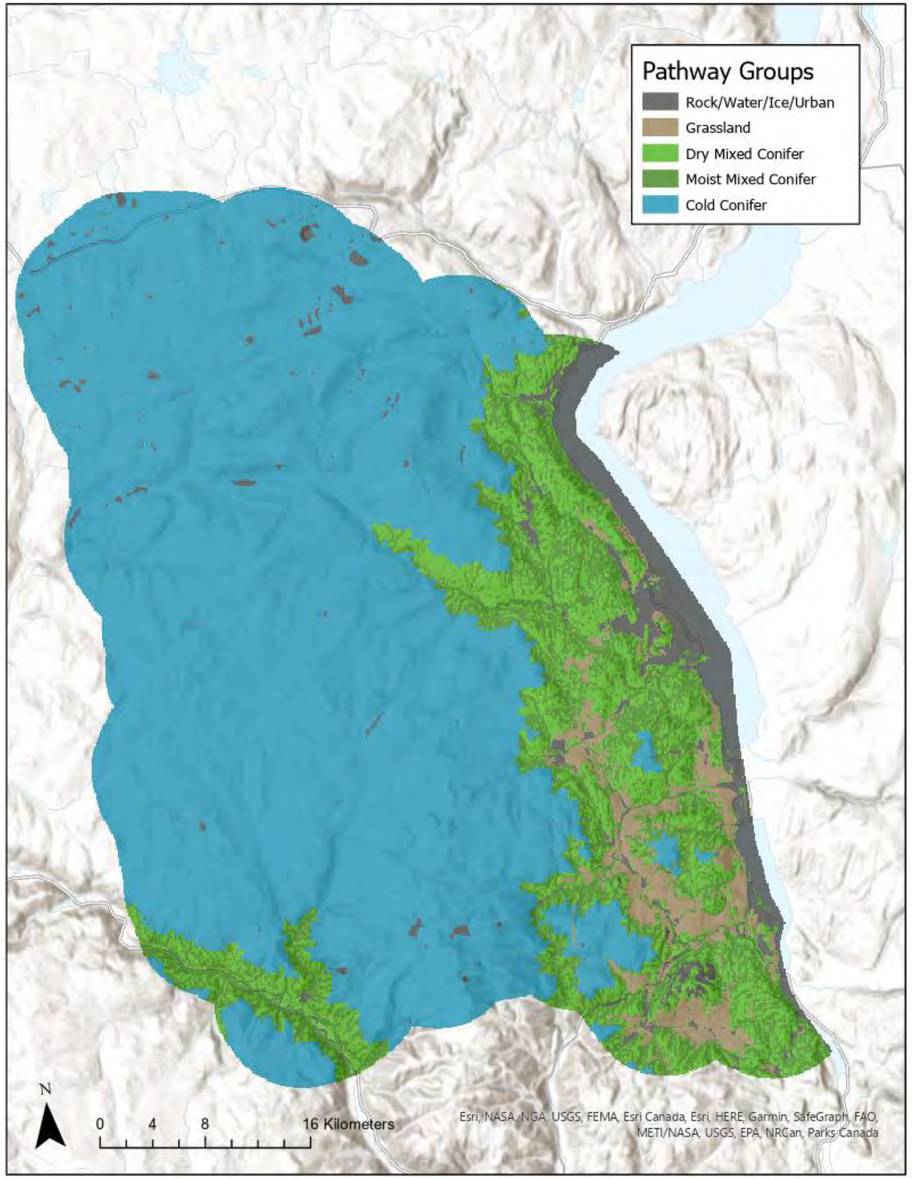

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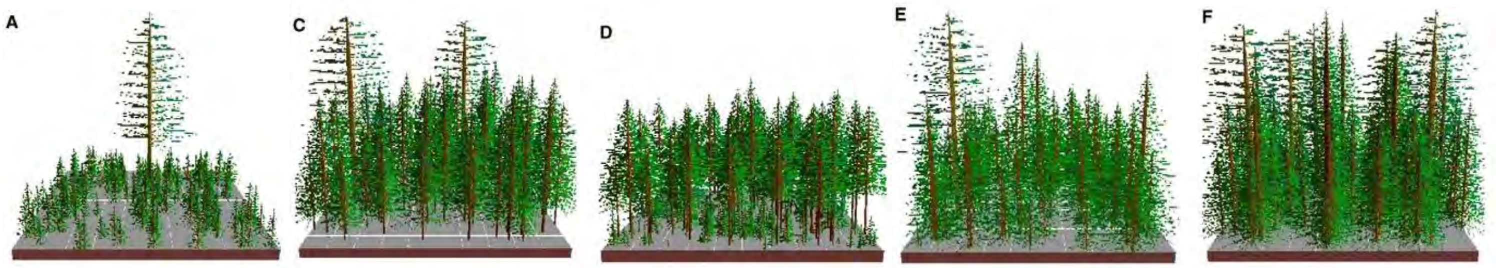


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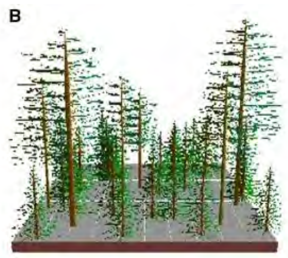
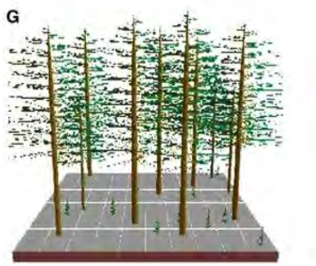
Fire 'Fences'




SEOC= Stem Exclusion Open Canopy

Altered structure due to low or moderate severity fire events

Also act as fire fences, or at least mitigate fire behaviour




OFSS = Old Forest Single Story

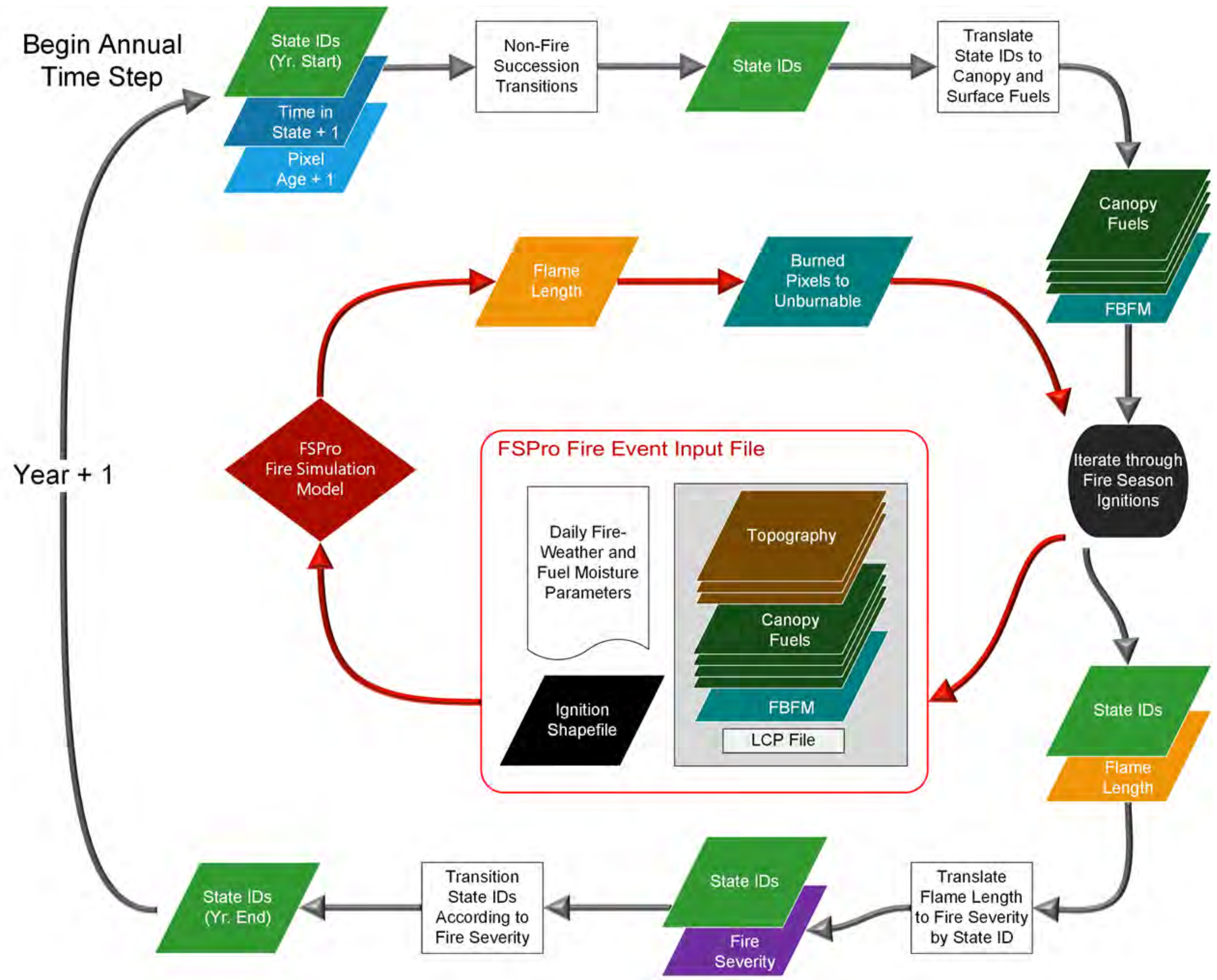
Fuel Parameters:

- Structure class
- Surface fuel model
- Canopy height
- Canopy bulk density
- Canopy base height
- Canopy cover

Used to evaluate:

- Fire behaviour
- Timber availability
- Carbon stocks
- Wildlife habitat

# FIRE SIMULATION MODEL



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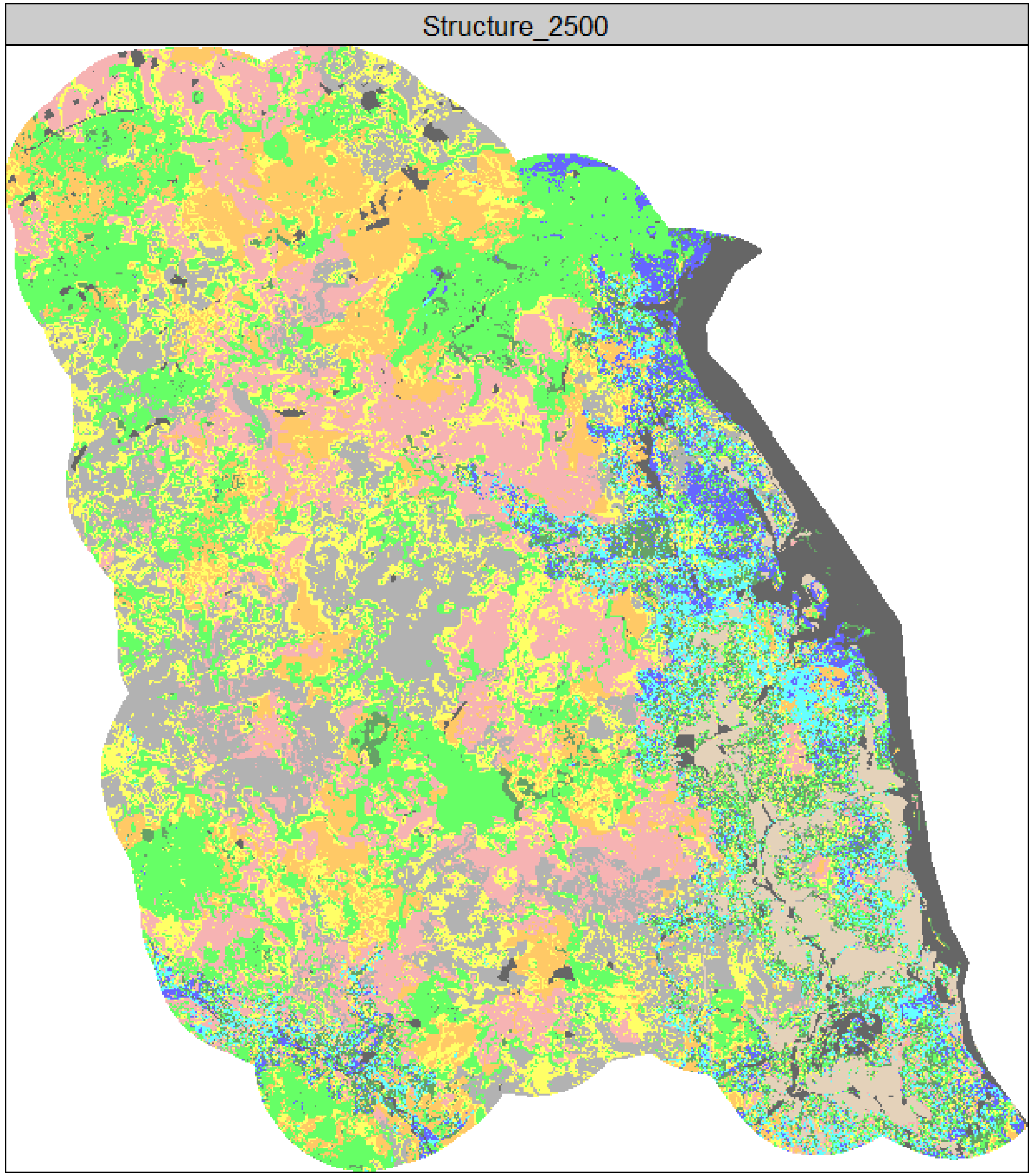


- The location of fences constantly shifts across the landscape.
- Fences only function for a short window of time, but new fences always emerge.
    - High severity fire creates regions of non-forest fences, burned and recovering areas.
    - Low and moderate severity fire patches shape the structure and composition of forest that remain on the landscape, canopy cover is typically open

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# INFLUENCE OF ASPEN

- Forest management has favored conifer species, and has actively suppressed growth of deciduous species (i.e., through use of silvicides and fire suppression)

- However, hardwoods are typically less flammable and can act as fire breaks, so aspen may have played a substantial role in historical landscape resilience

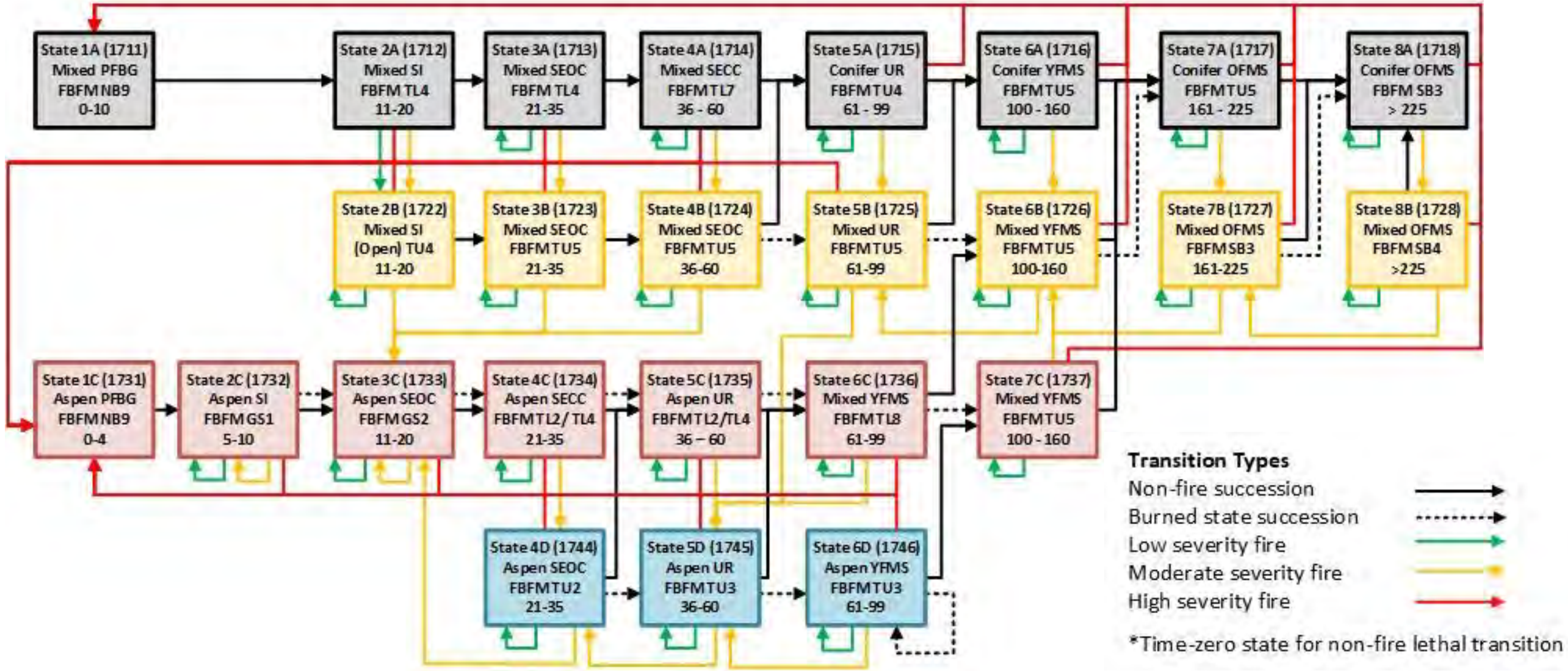
Key research questions:

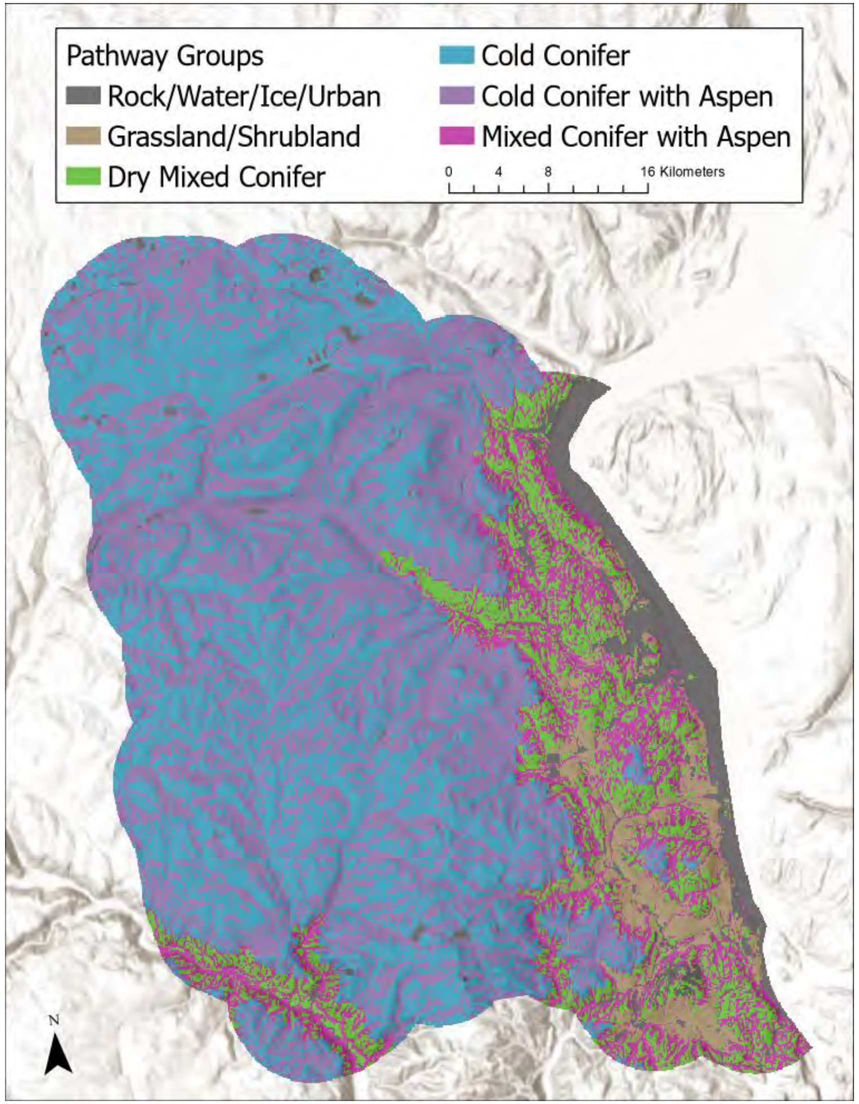
1. How much was present across the landscape? How did that vary over time?

2. How would the reintroduction of aspen influence the balance of forest and non-forest required to achieve a stabilized landscape with lower variance in forested area?

# INFLUENCE OF ASPEN

- Mapped areas with potential for aspen growth based on tree feasibility maps & topoedaphic settings
- Created state transition models that reflect interactions between fire, forest structure and species composition



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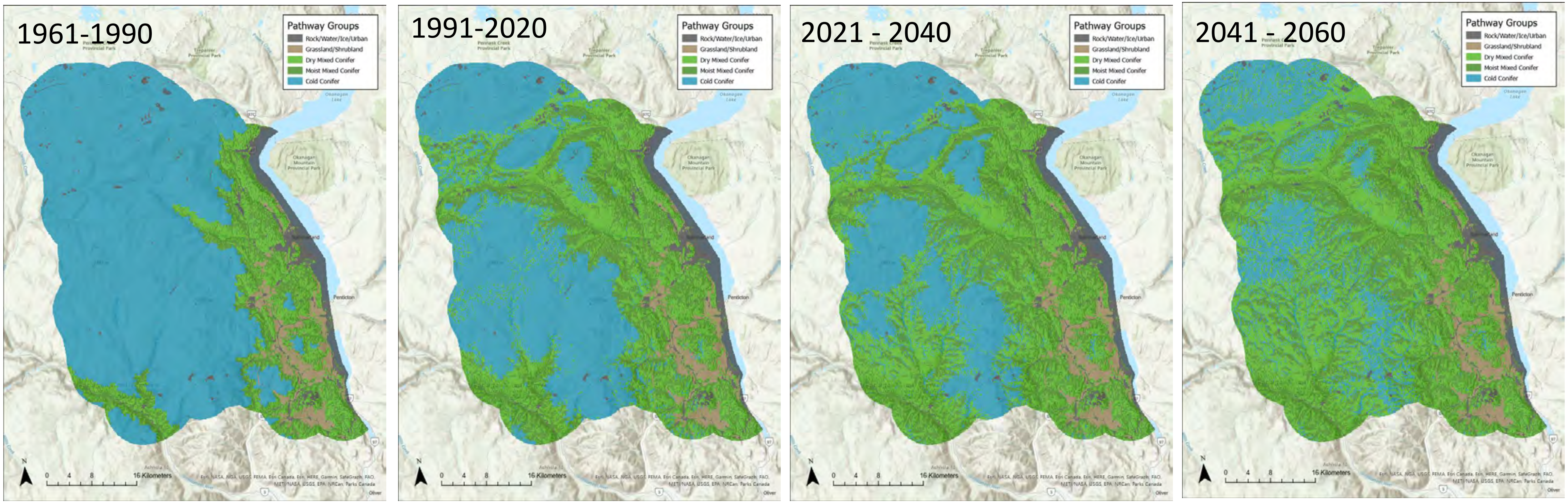
# CLIMATE CHANGE




**How will changes in weather and shifting species ranges affect the conditions of a resilient landscape?**

- Impact of changes in climate on daily weather, fuel moisture and ignition probability
- Shifting species ranges due to climate (using predicted tree feasibility ratings)

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# FOREST MANAGEMENT

- Management activities will include clear cut, thinning and prescribed burning
- Need to add these disturbances into the state and transition models
- Want to understand how much needs to be treated and in what spatial arrangement


# SUMMARY & CONCLUSIONS

**Research Objectives**

1. What created landscape level forest resilience in the past?
2. Did hardwoods play a role in resilience in the past, and could they play a role in the future?
3. How will the characteristics of resilience change under a future climate?
4. How can management tools be used to create this resilience?

**Progress to date – lessons from historical landscapes & climate**

- Fire ‘fences’ comprised a large component of historical landscapes, especially in high elevation cold conifer forests
- These fences are nonstationary across space and time.

**What’s next:**

- Finish model development by incorporating aspen, climate change and forest management

Thank you to the Pacific Institute for Climate Solutions for funding this research.

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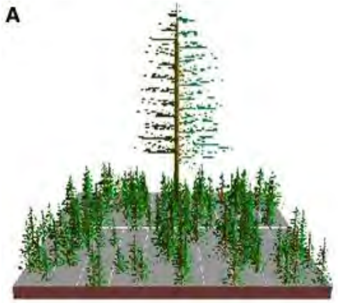


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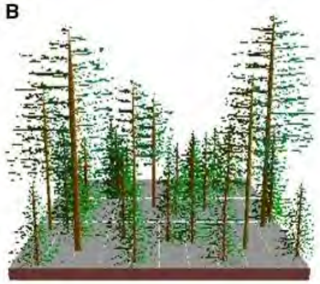


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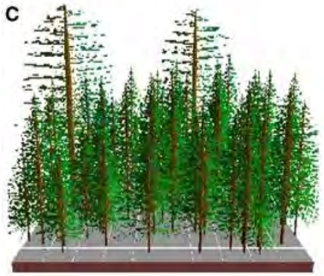


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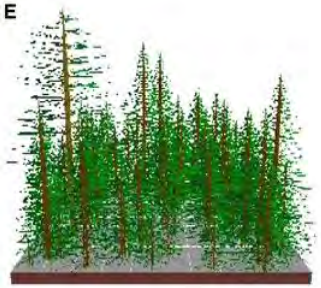


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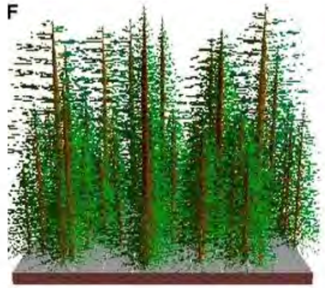


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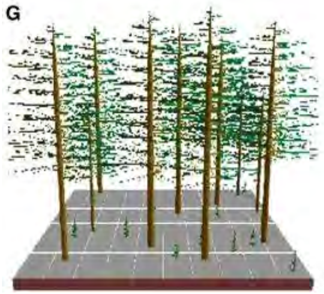


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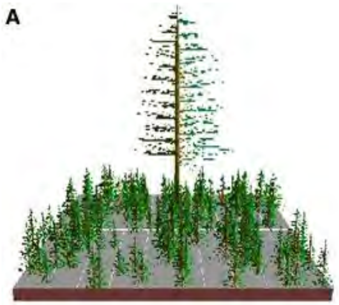


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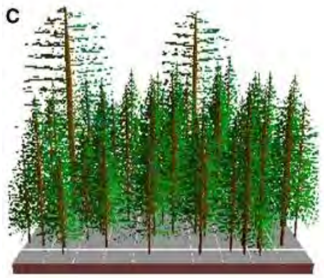


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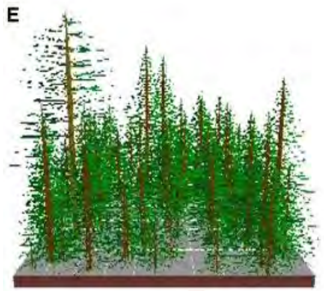


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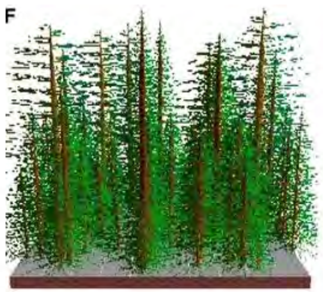


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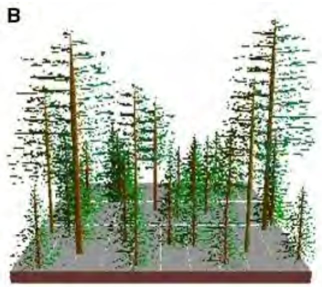


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