

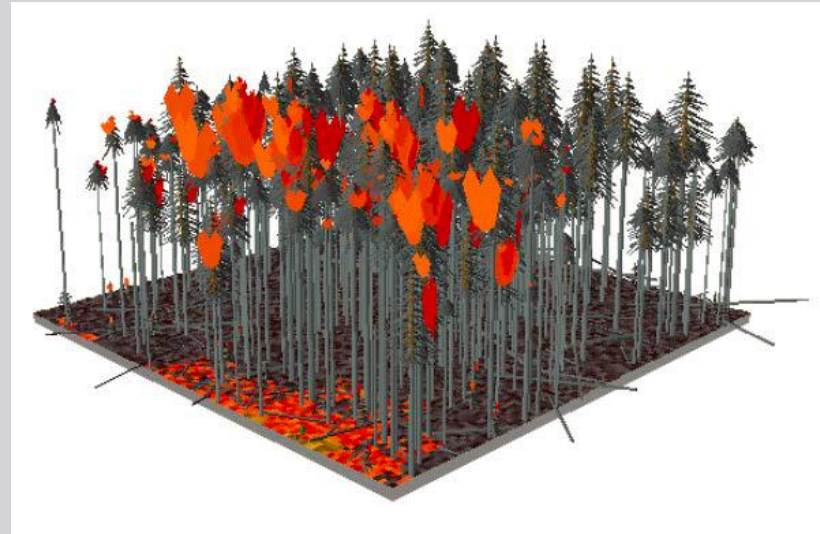
Fuel accumulation, fire behavior and effects modeling



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Objective of presentation

- Demonstrate FFE-FVS results of thinning
 - Fuel loads
 - Fire behavior (surface)
 - Torching and crown fire
 - Mortality
 - Soil heating



Stand characteristics

Ins_#	Region	Thin	Target Sp	Lat	Long	Ele	Hab Type	Surface Soil 1	Surface Soil 2	Parent Material 1
610	NEWA	14, 18	DF	48.40	118.05	3884	ABGR /LIBO	Ash	Vitr(Andic)	Metased (Quartzite)
2004	NID	14, 18	DF	46.76	116.28	2858	THPL/CLUN	Ash	Andisol	Meta Calsilicate/Gneiss
2006	NID	14, 18	DF	46.73	115.68	3452	THPL/ASCA	Ash	Andisol	Granite
600	NID	14, 18	DF	47.20	-116.71	3167	THPL/ASCA	Ash	Andisol	Metased - Siltite/Argillite

Ins_#	TPA	QMD	SDI ^(1.605)	DF_BA%	GF_BA%	PP_BA%	WL_BA%	OTHER_BA%
610	1370	2.9	189	69	6	23	0	2
2004	1440	2.3	137	84	4	0	1	11
2006	1840	2.9	255	75	21	0	0	4
600	450	6.8	242	93	4	0	0	3

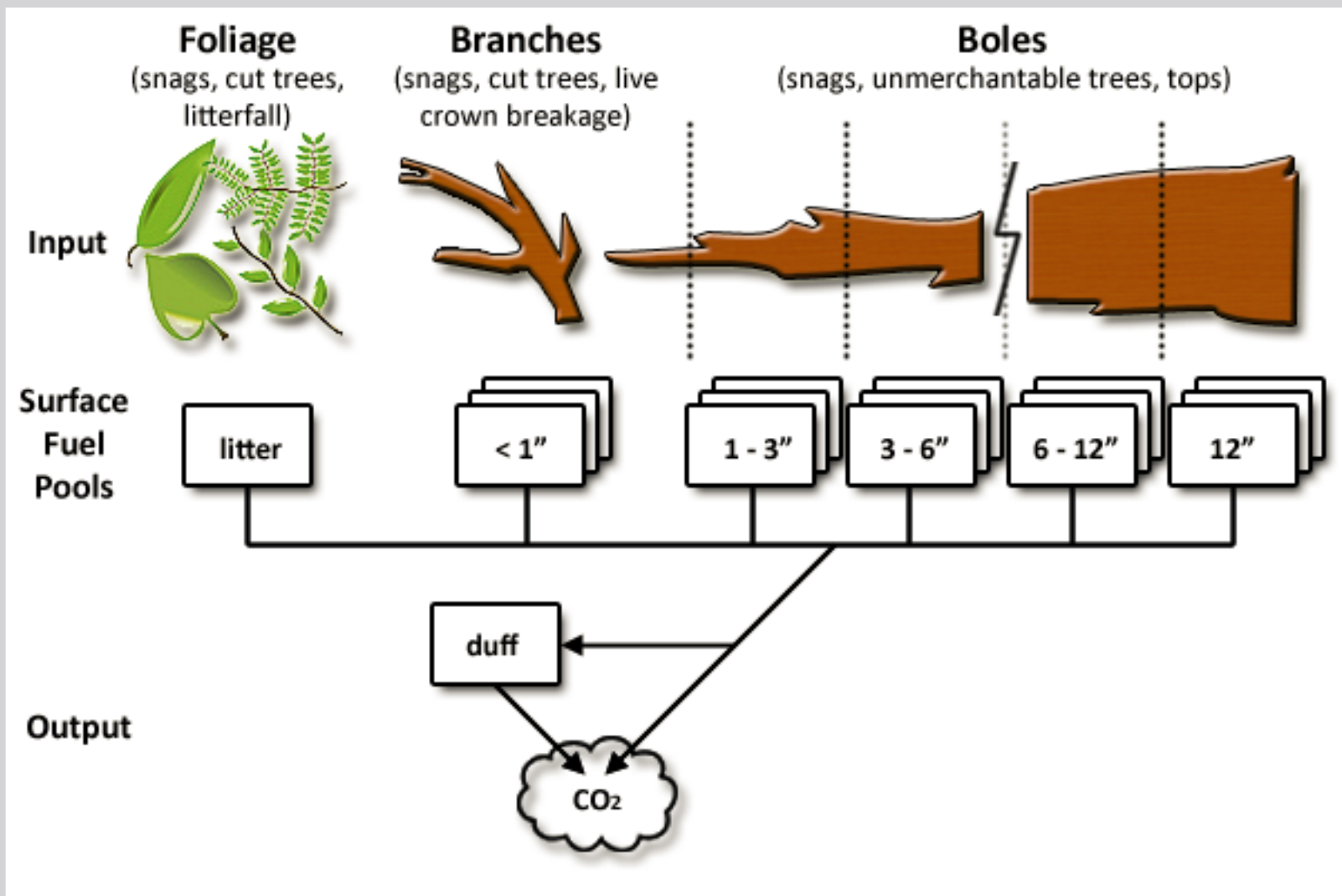
Treatments

Thinning treatments in 2013

- Control
- Light thin 14' (TPA 220)
- Heavy thin 18' (TPA 130)

- 100 year simulation in FVS with Fire Fuels Extension (FFE)

Fuel: Non-living biomass



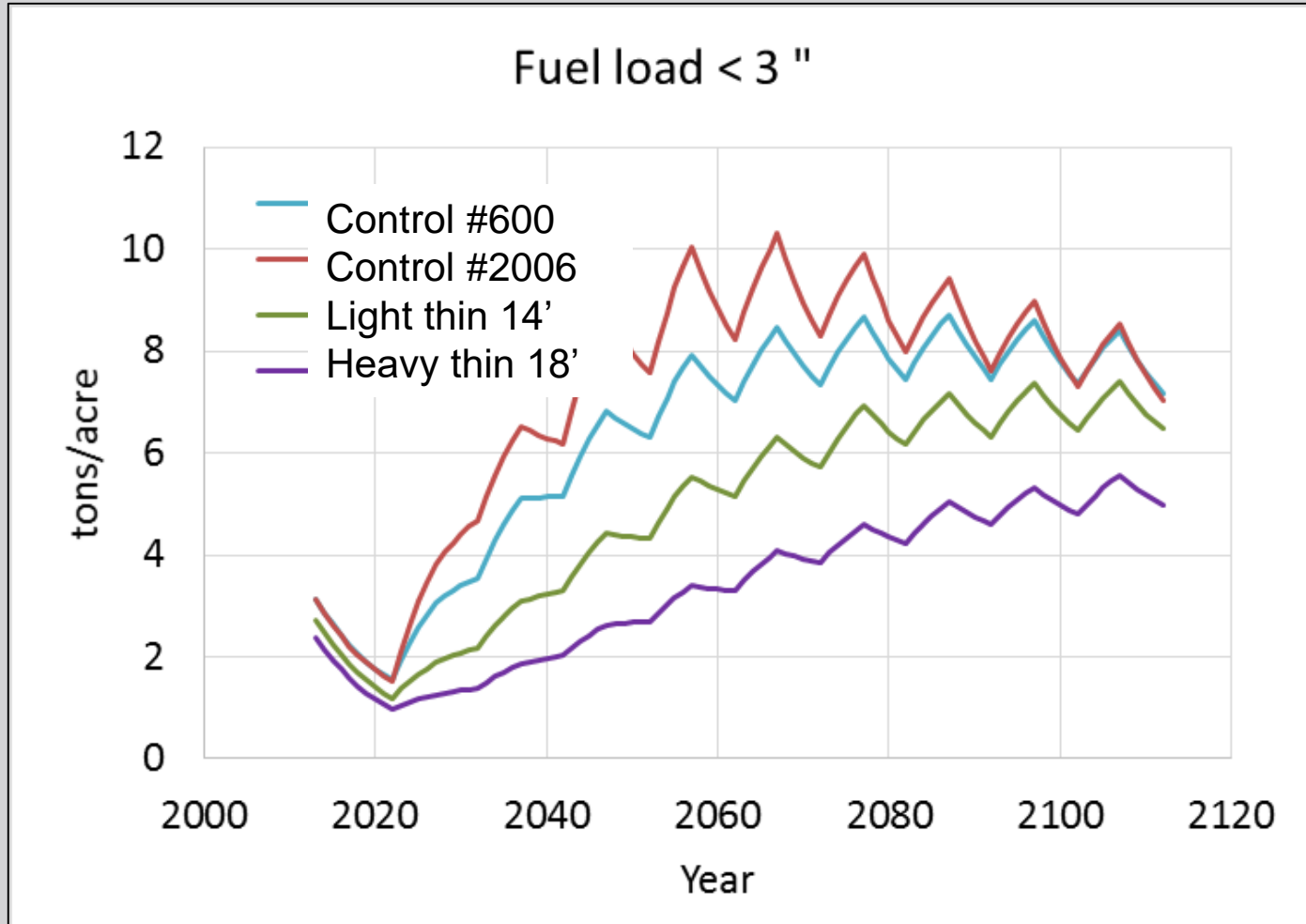
Live biomass can also burn

The fuel submodel also tracks the biomass of aboveground live tree components (crown and bole) as well as a nominal measure of live herbs and shrubs in the stand

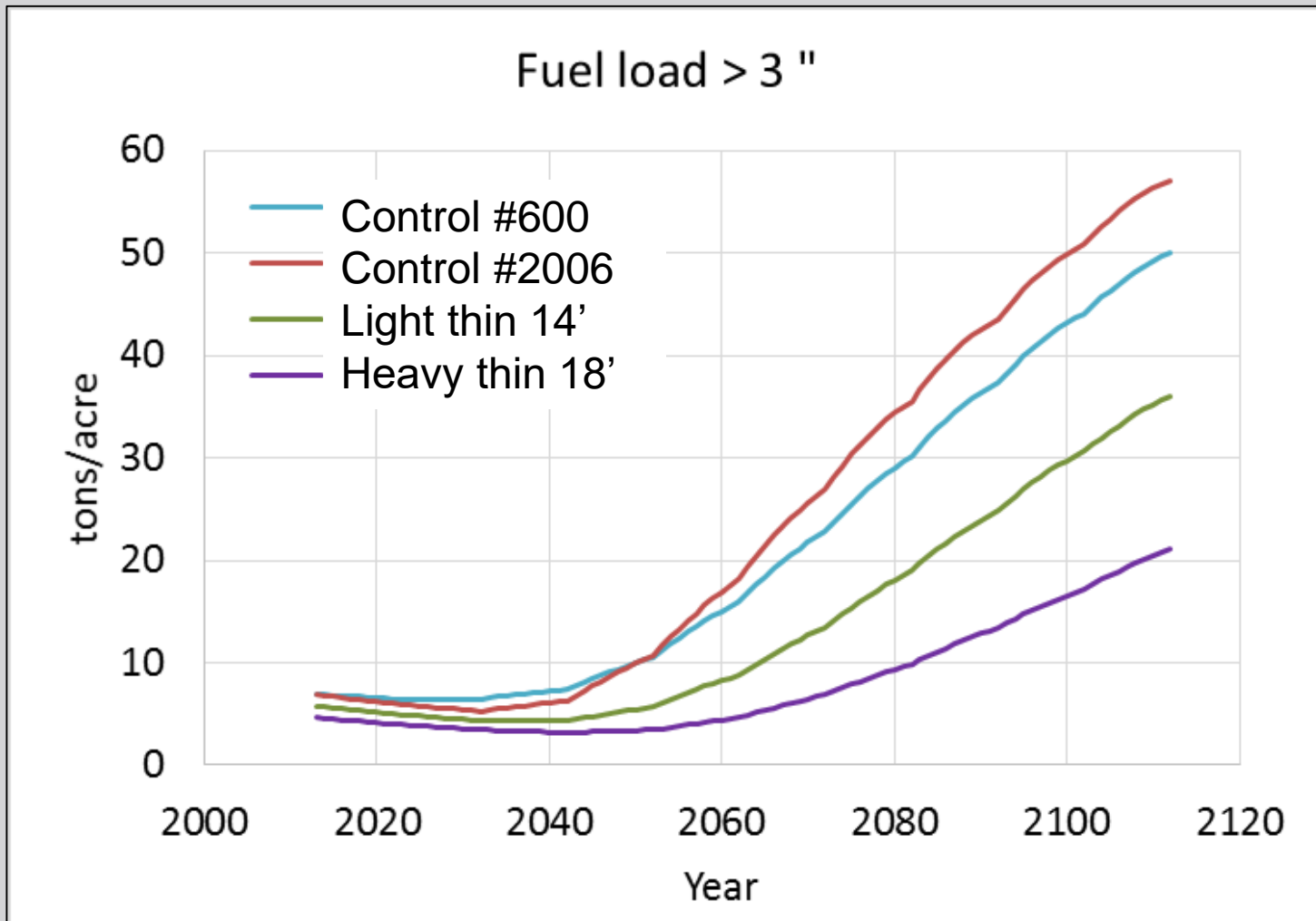


Photo FFEguide Andrew Sánchez Meador

Fuel loads: Fine woody debris < 3"

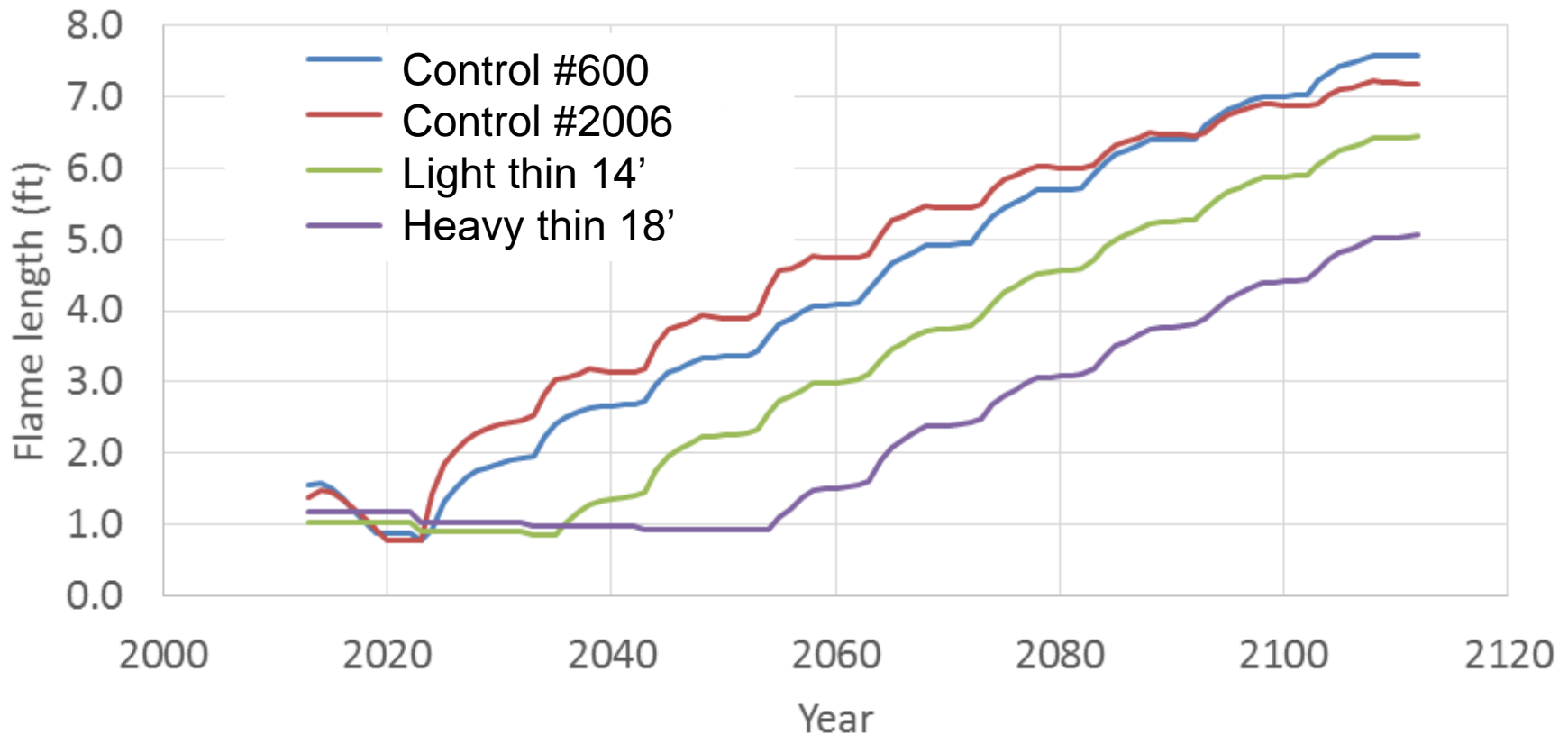


Fuel loads: Coarse woody debris > 3"



Flame Length Surface Fire

Surface Fire Flame Length - Severe Conditions



Torching Index

- Torching index is the 20-foot wind speed (mph) at which a surface fire is expected to ignite the crown layer
- Depends on surface fuels, surface fuel moisture, canopy base height, slope steepness and wind reduction by the canopy
- As surface fire intensity increases (with increasing fuel loads, drier fuels, or steeper slopes), or canopy base height decreases, it takes less wind to cause a surface fire to become a crown fire
- Crown fire hazard is greater at lower index values



Crowning Index

- Crowning index is the 20-foot wind speed (mph) needed to support an active or running crown fire.
- Depends on canopy bulk density, slope steepness, and surface fuel moisture content.
- As a stand becomes more dense, active crowning occurs at lower wind speeds
- Crown fire hazard is greater at lower index values



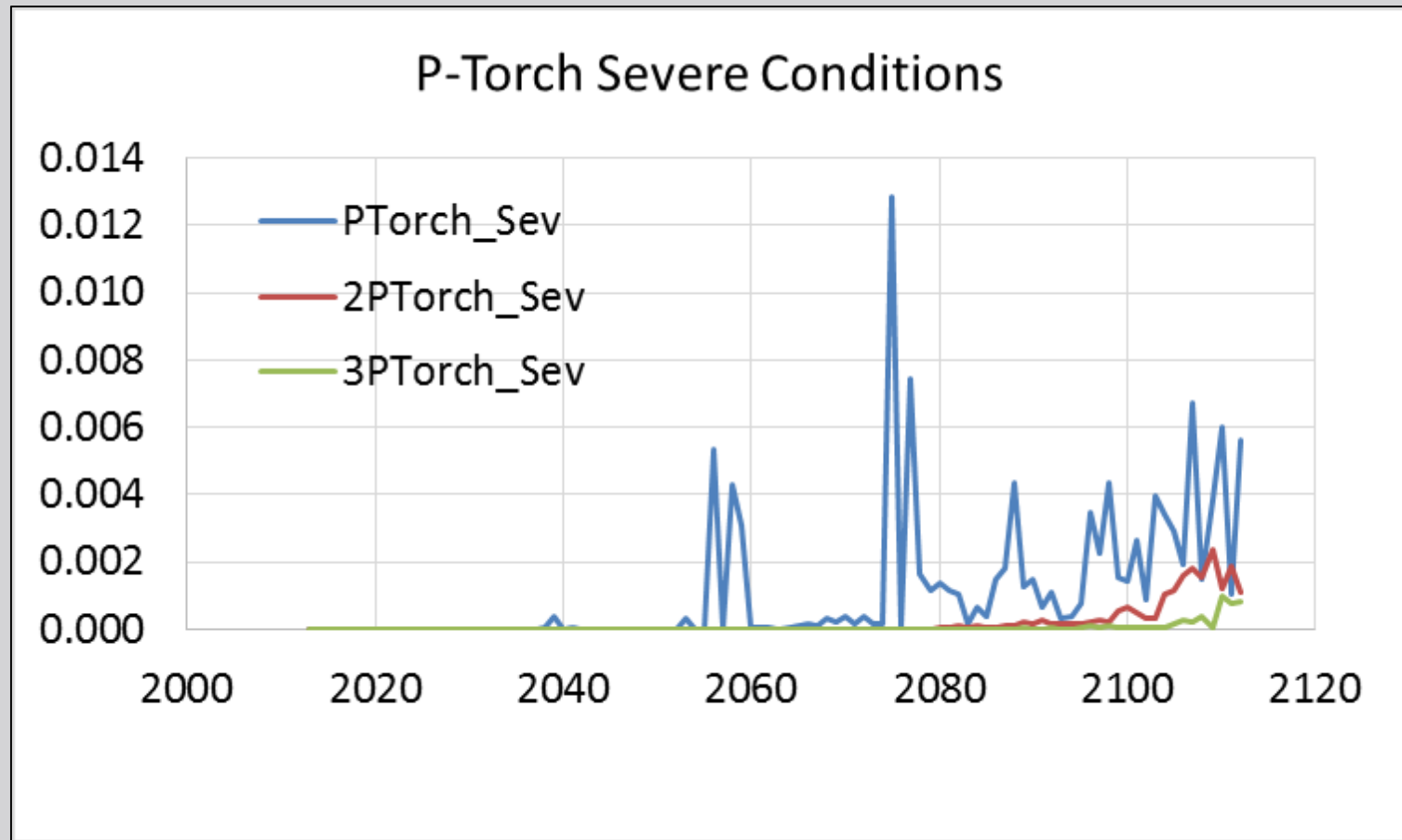
Wallow Fire AZ, Kevin Bendict

Rules for determining crowning

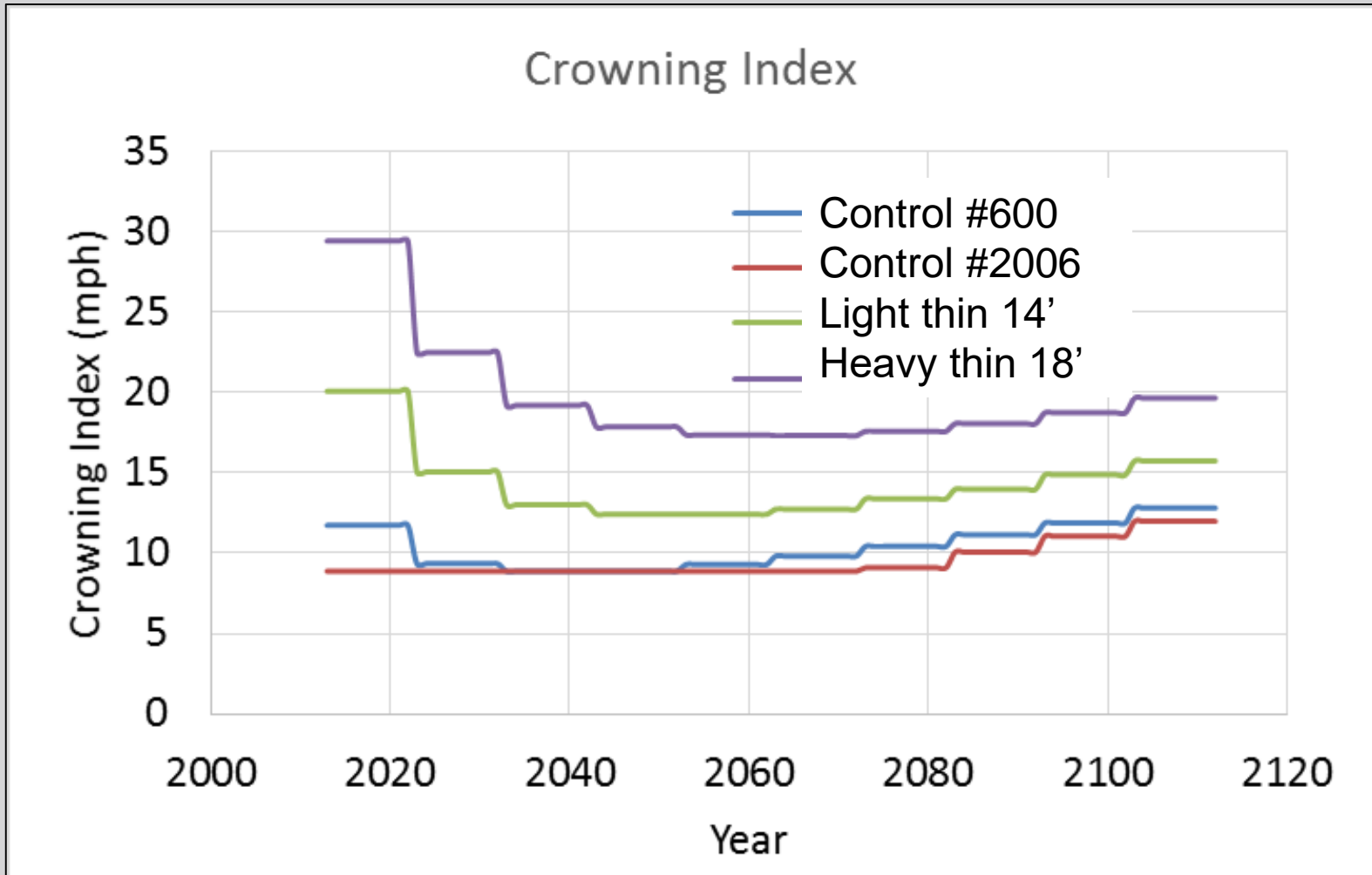
	Torching Index < Wind Speed	Torching Index > Wind Speed
Crowning Index > Wind Speed	PASSIVE	SURFACE
Crowning Index < Wind Speed	ACTIVE	CONDITIONAL

- Wind speed is the 20-ft wind speed (mph) at the time of the fire
- Both indices depend on surface fuel moisture
- Drier conditions produce lower indices, indicating risk of crown fire
- Temperature and wind speed do not affect the indices

Probability of Torching



Crowning Index



First Order Fire Effects Model (FOFEM)



First order fire effects are the direct and immediate consequences of a fire.

- **Tree mortality**
- **Soil heating**
- Perennial shrub and herb mortality
- Seed bank reduction
- Mineral soil exposure
- Water repellent soil formation
- Smoke production
- Fuel consumption

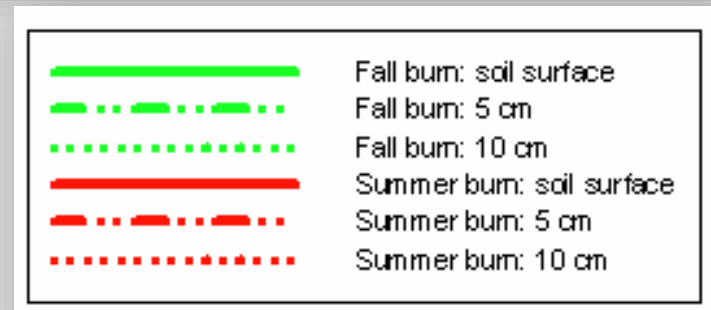
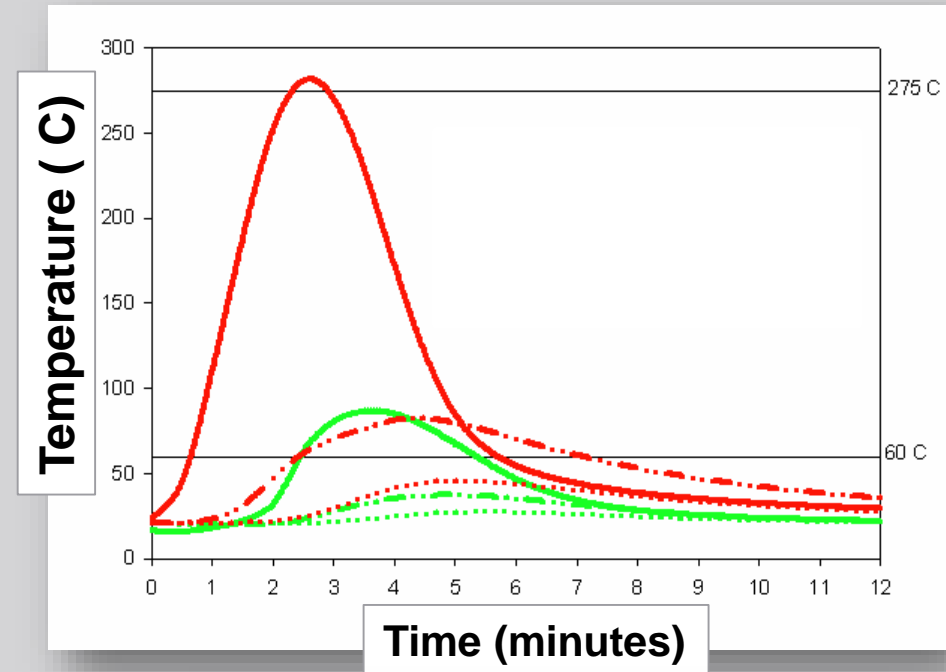
Fire Effects - Soil

- Deepest depth reaching 60 Degrees Celsius
- Deepest depth reaching 275 Degrees Celsius
- Surface temperature (Degrees Celsius)
- Percent mineral soil exposed



Soil Heating Computations

- Heat from the surface fire contributes to soil heating
- If duff is burning, smoldering duff is the heat source
- If duff is not burning, other fuels drive the heating
- Duration and temperature depth play a significant role in the effects of soil heating

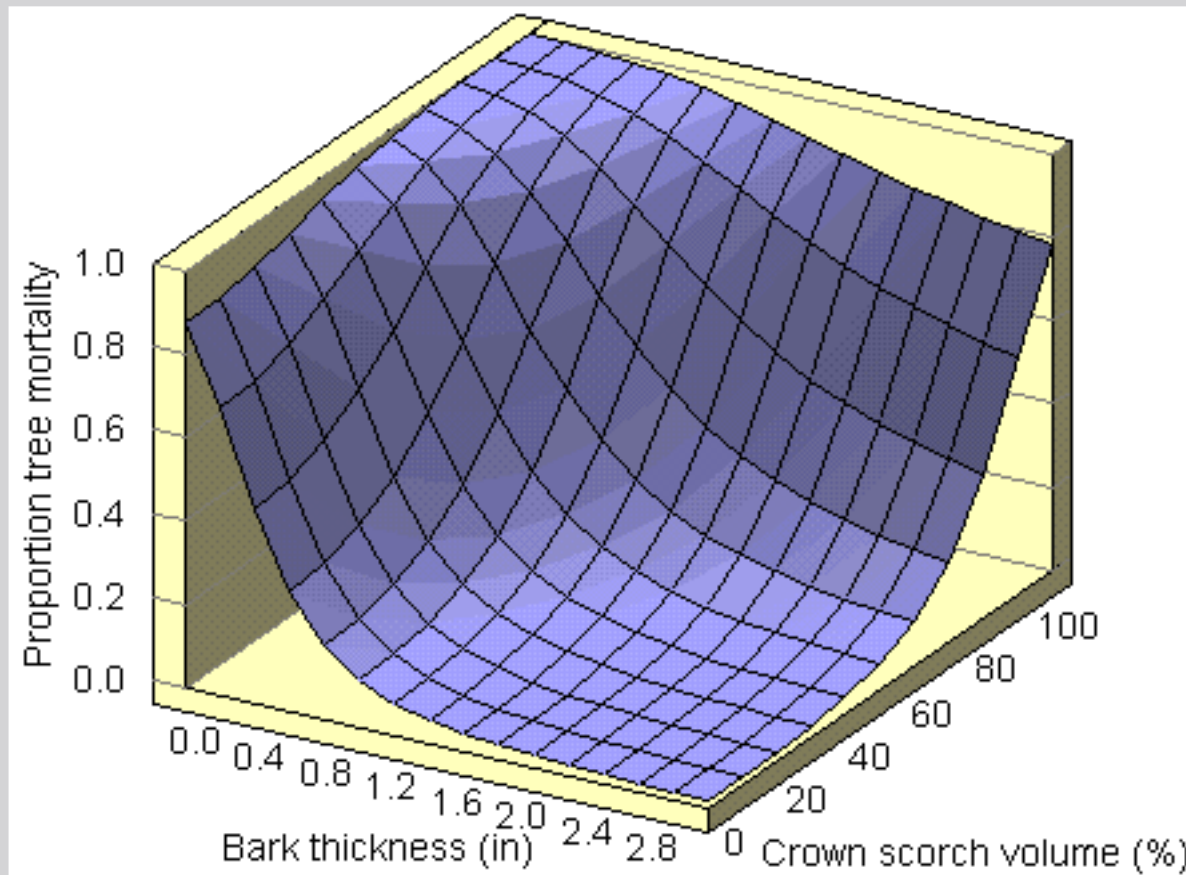


Fire Effects – Tree Mortality

- Percent Tree Mortality
- Percent Basal Area Mortality
- Average diameter (DBH) of fire killed trees

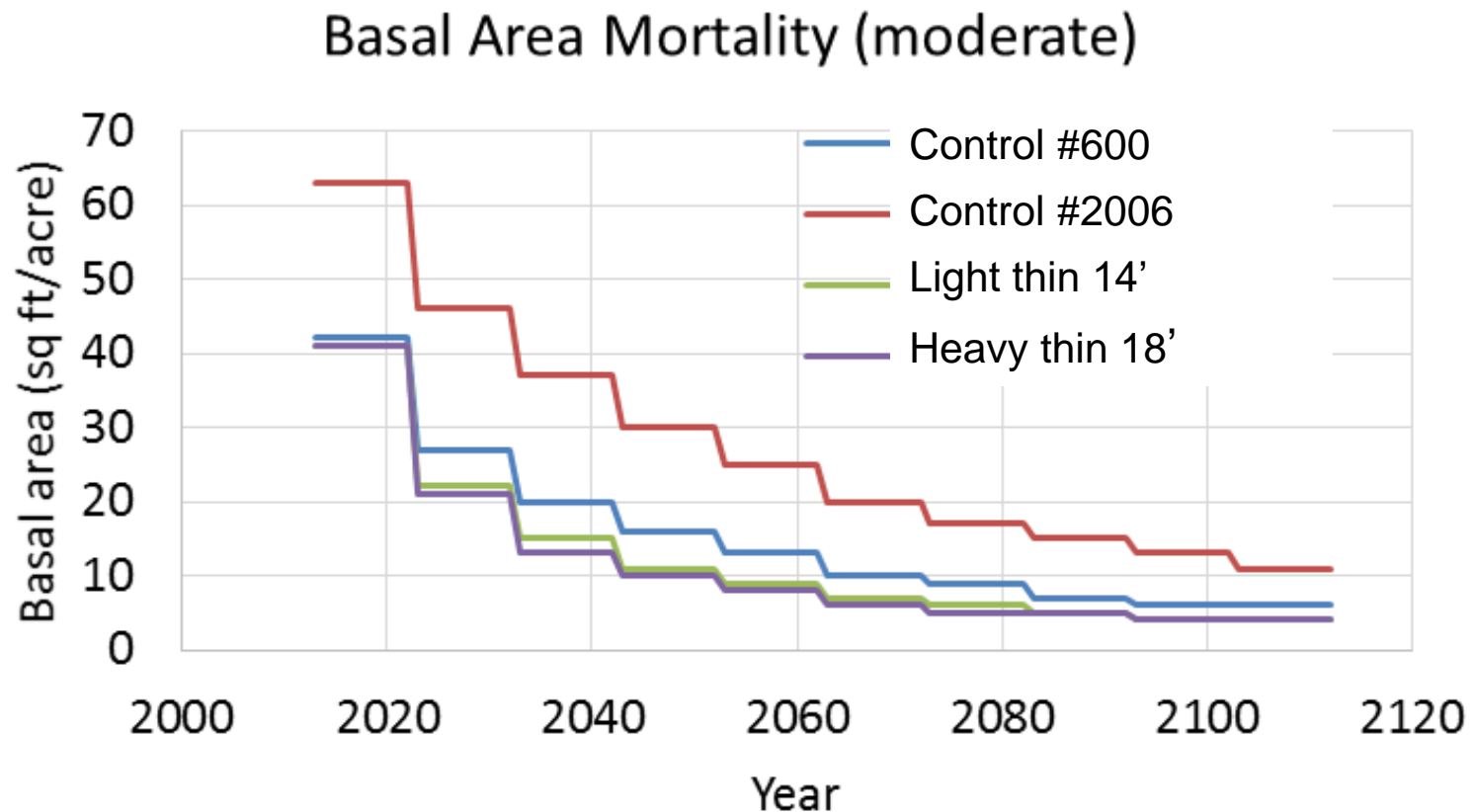


Bark thickness and Crown scorch predicts tree mortality

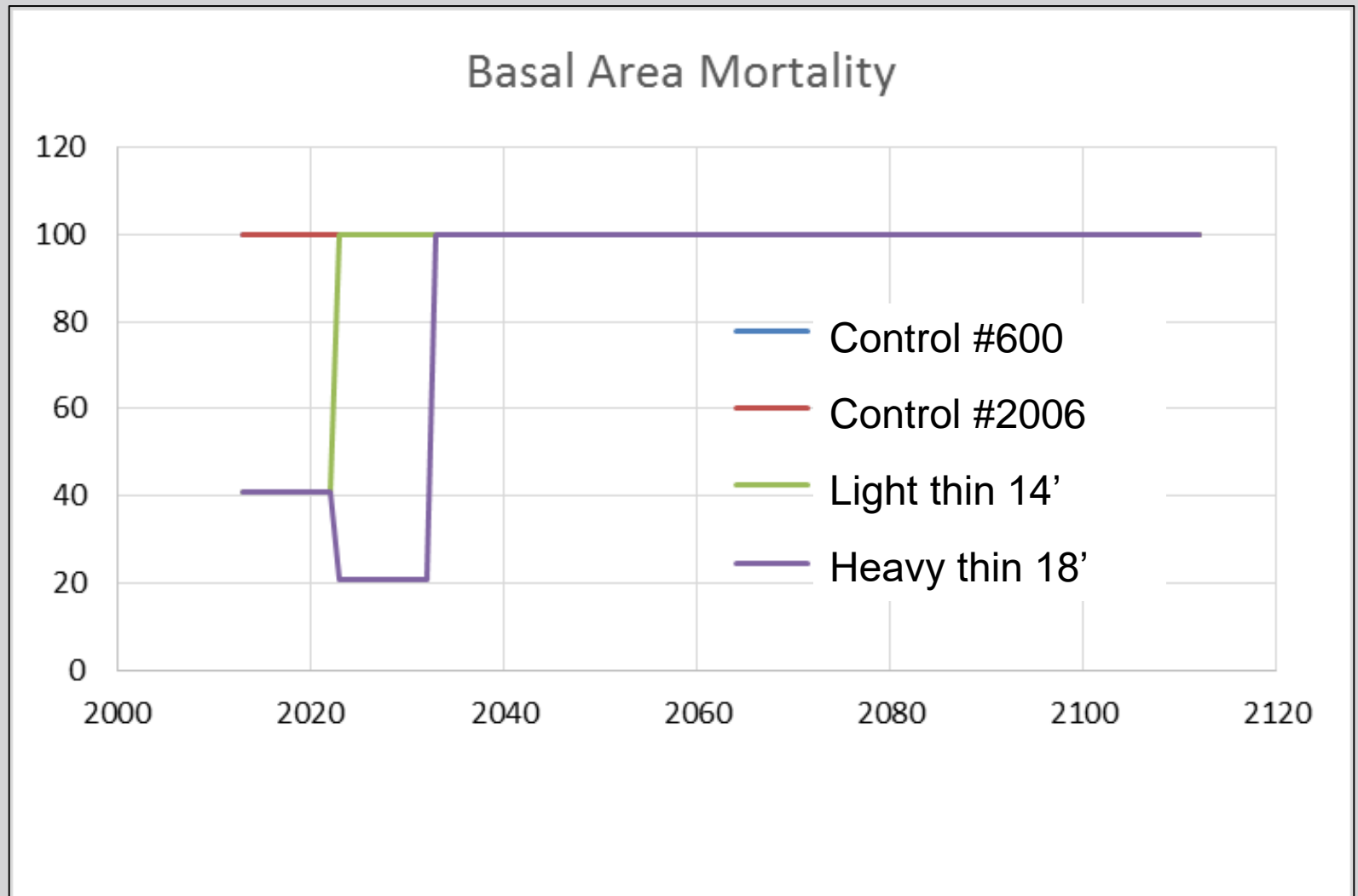


Mortality caused by soil heating?

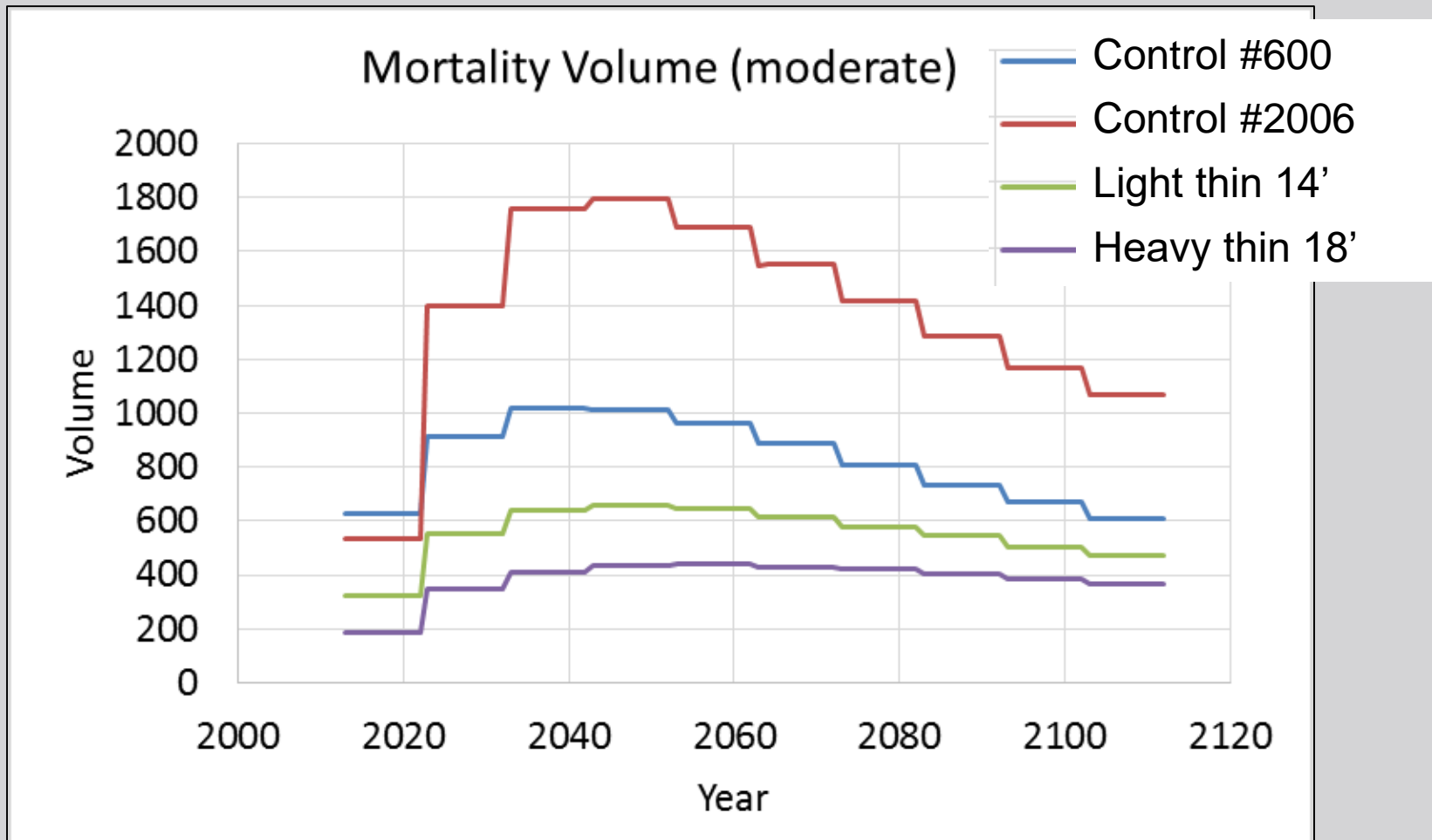
Basal Area Mortality (moderate)



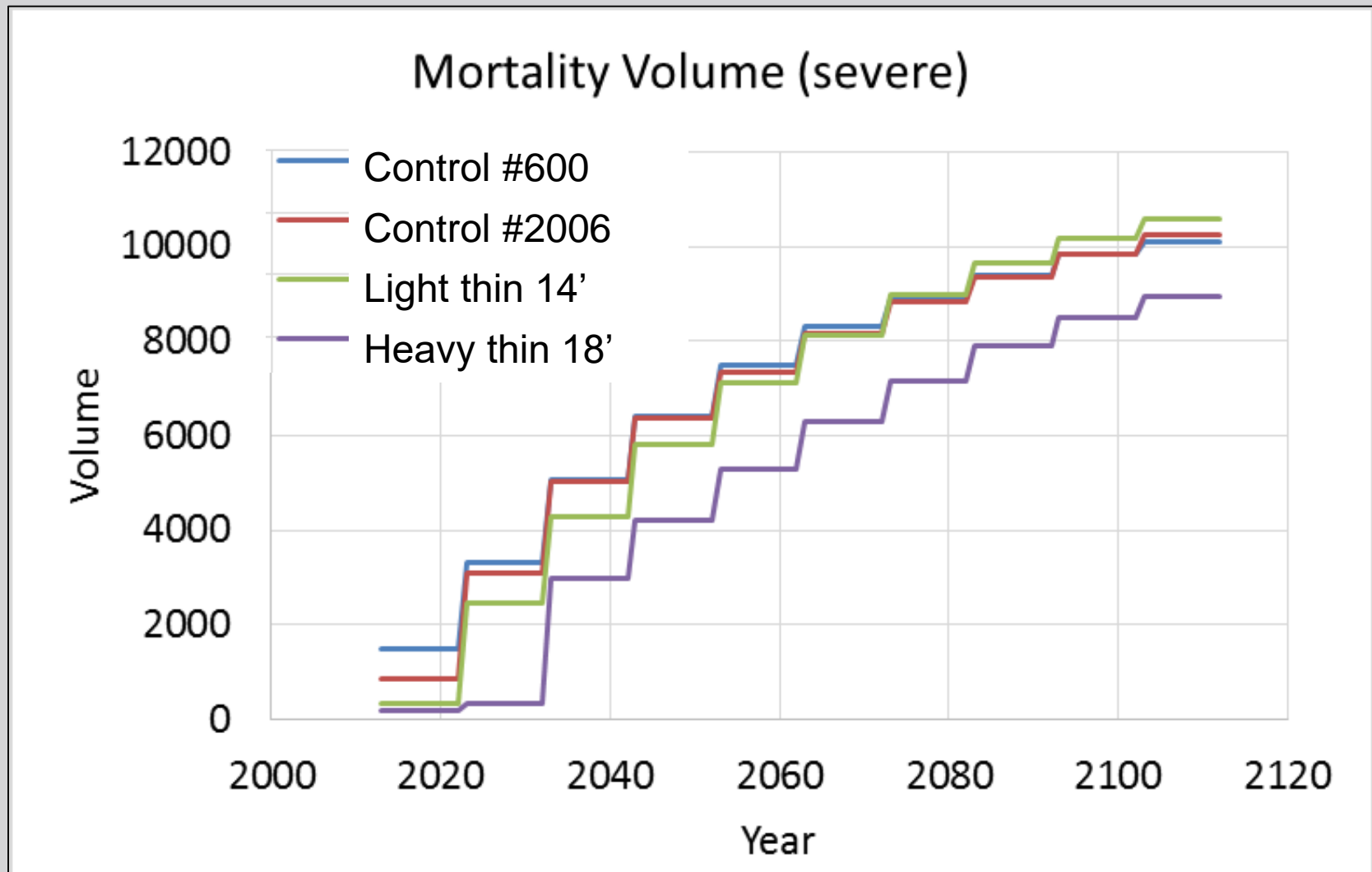
Basal Area Mortality (severe)



Mortality Volume (moderate)



Mortality Volume (severe)



Conclusions Thinning Impacts

Fire related thinning impacts

- Fuel loads
- Fire behavior
- Crown fire risk
- Soil heating during a potential fire
- Tree mortality in a potential fire
 - Fire conditions impact success of treatments

