A Whole Stand, Lifespan Yield Model for the Red Pine and Aspen Forest Types in Minnesota

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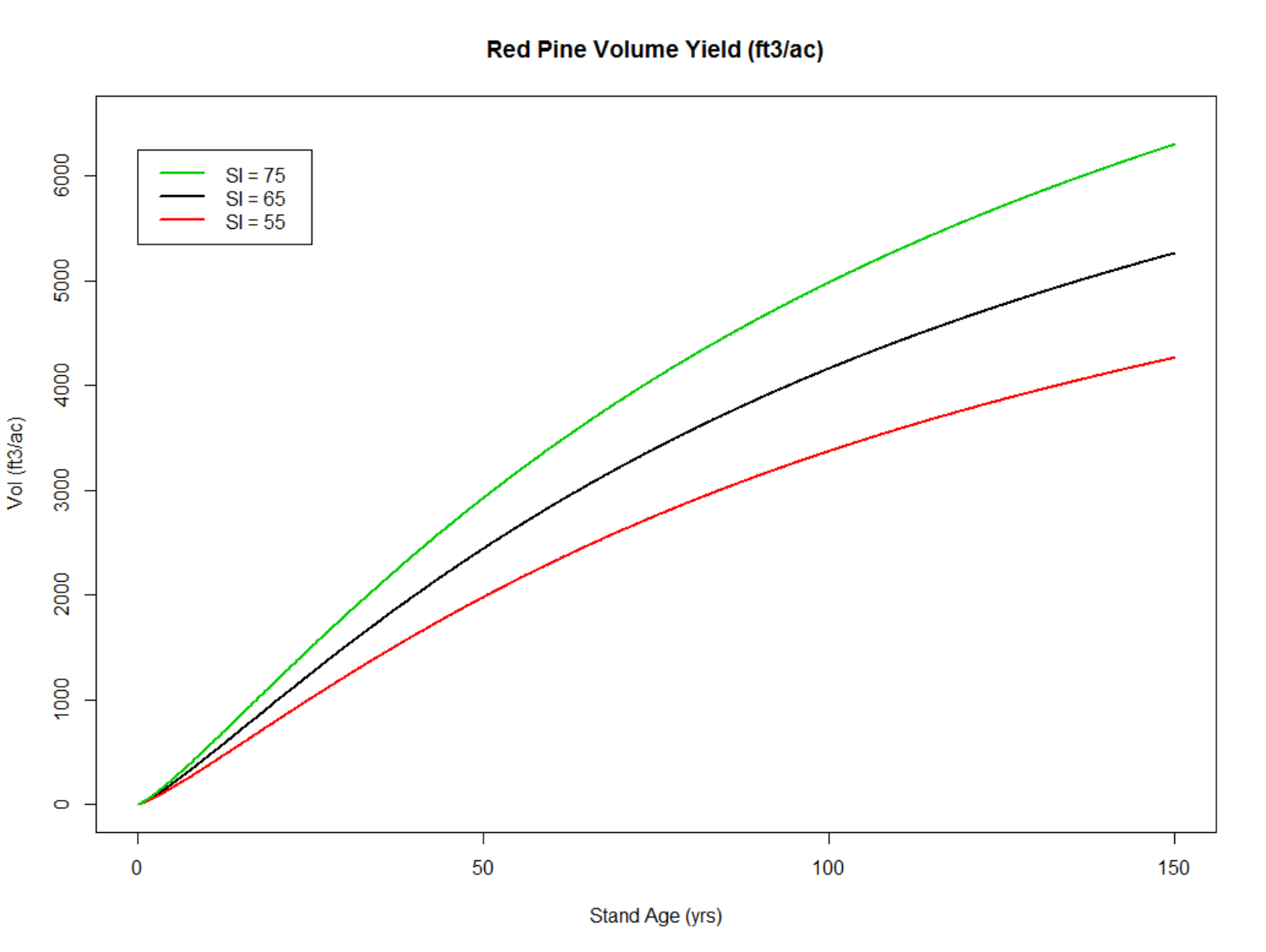
Introduction



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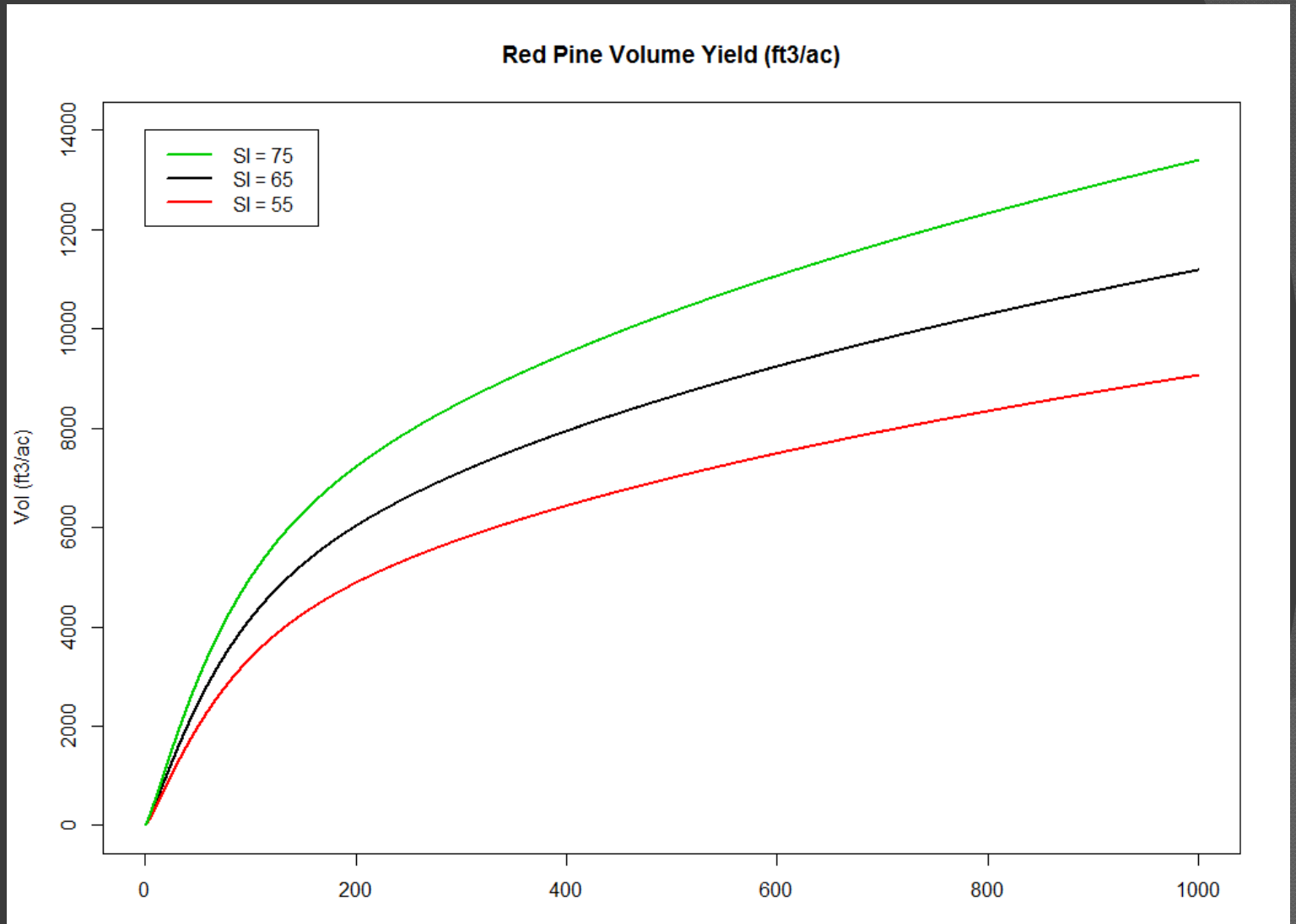

urpose/Methods

Objectives

- Create a realistic yield curve…one that does not perpetually increase
- Represent the entire lifespan of a stand
- **Use the model to explore implications of extended rotation ages (e.g., ERF policies)**

Data Available

- Younger stands: Readily available, e.g., from Forest Inventory & Analysis (FIA)
- Older stands: Very limited to non-existent

Methods: *Model*

Conceptual Model

- Assumptions
  - Models are for single stand (age cohort)
  - Cumulative growth = cumulative mortality (i.e. eventually 100% mortality)
  - Maximum age for species (forest types)
  - Undisturbed / untreated stand
  - Even- or uneven-aged system
- Approach
  - Modifies basal area equation (stand density)
  - Revised basal then affects volume yield

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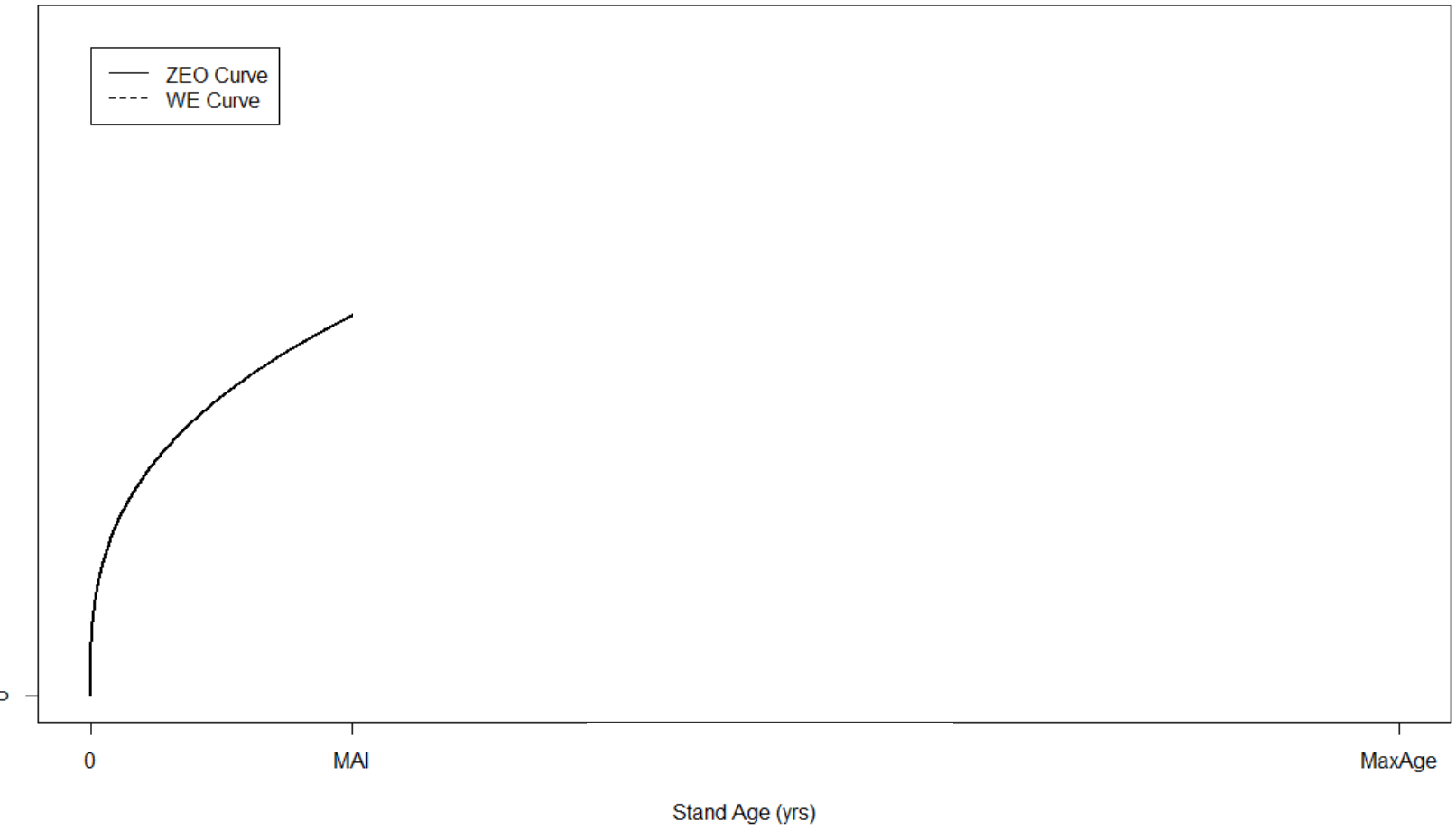
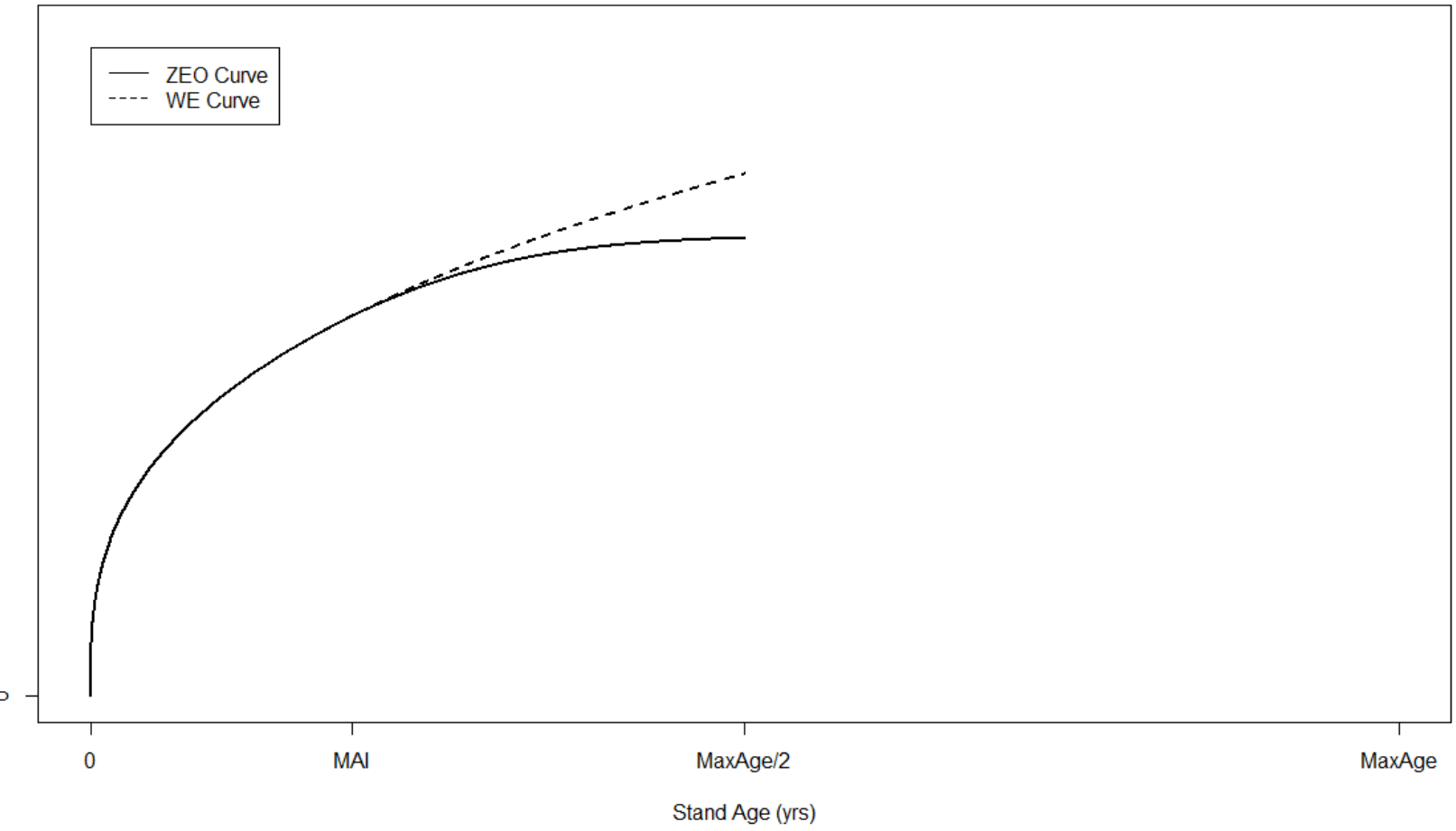
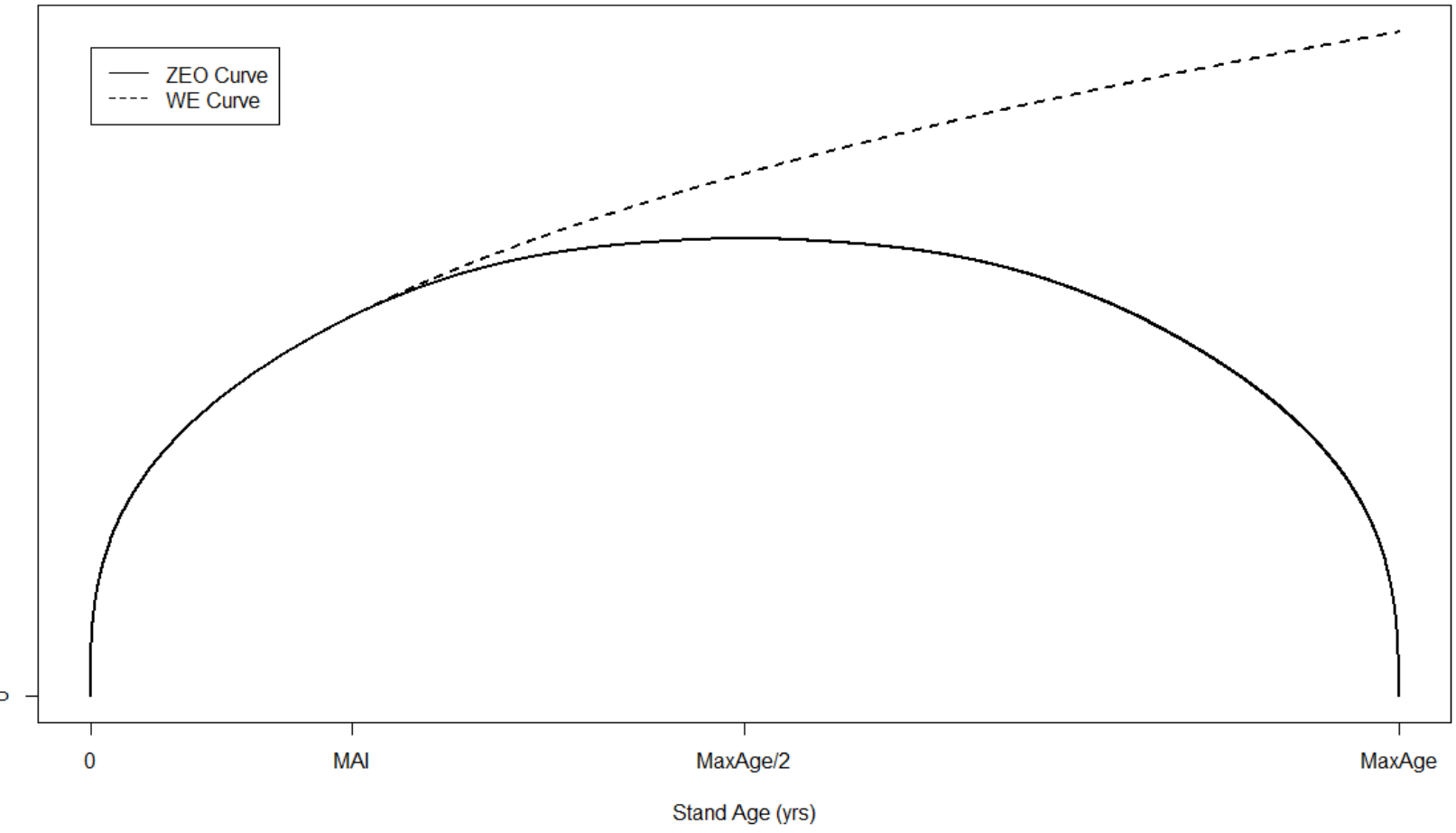
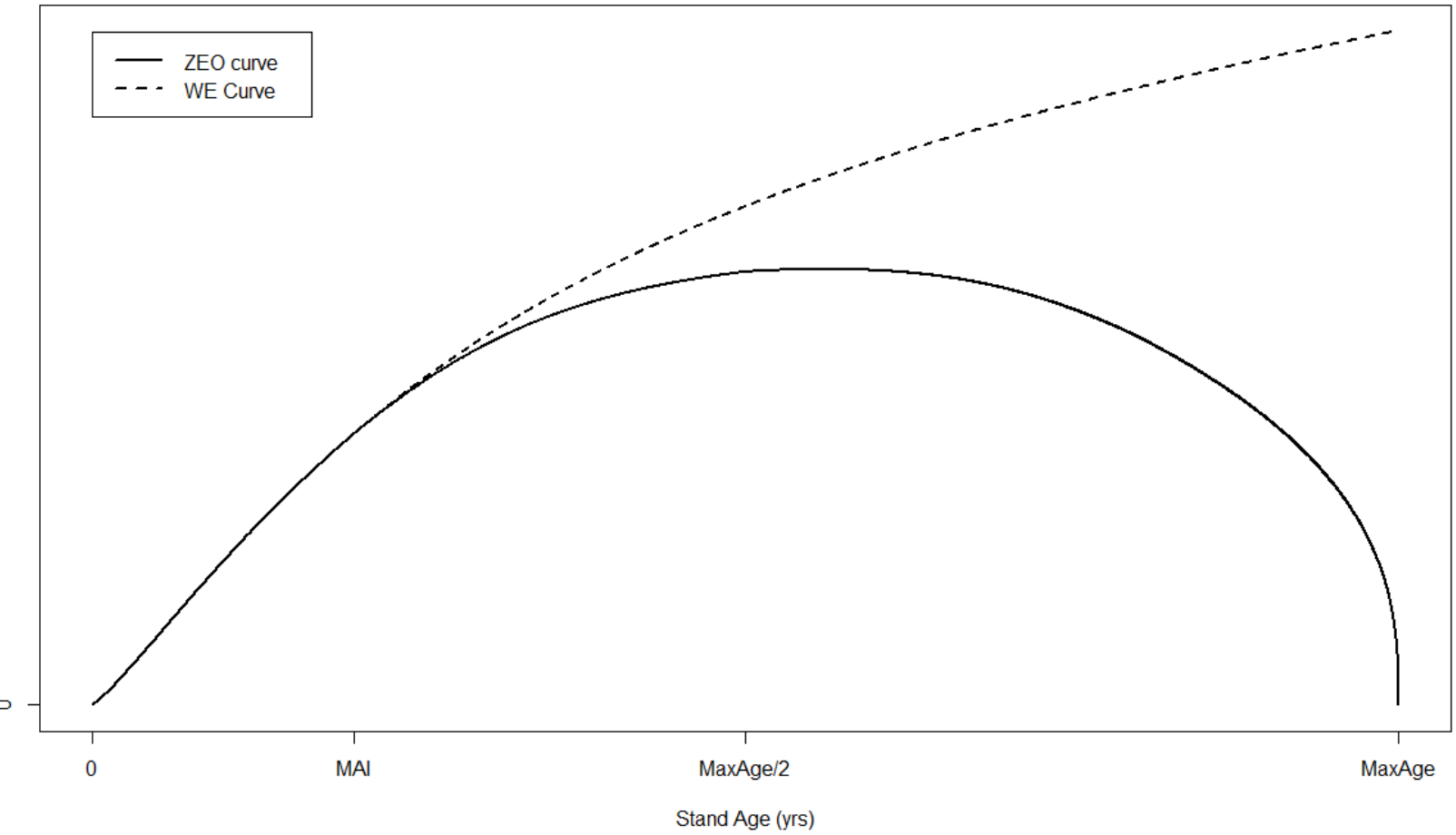

ZEO Curve
WE Curve
0
MAI
MaxAge
Stand Age (yrs)


ZEO Curve
WE Curve
0
MAI
MaxAge/2
MaxAge
Stand Age (yrs)


ZEO Curve
WE Curve
0
MAI
MaxAge/2
MaxAge
Stand Age (yrs)


ZEO curve
WE Curve
0
MAI
MaxAge/2
MaxAge
Stand Age (yrs)

Methods: *Mortality*

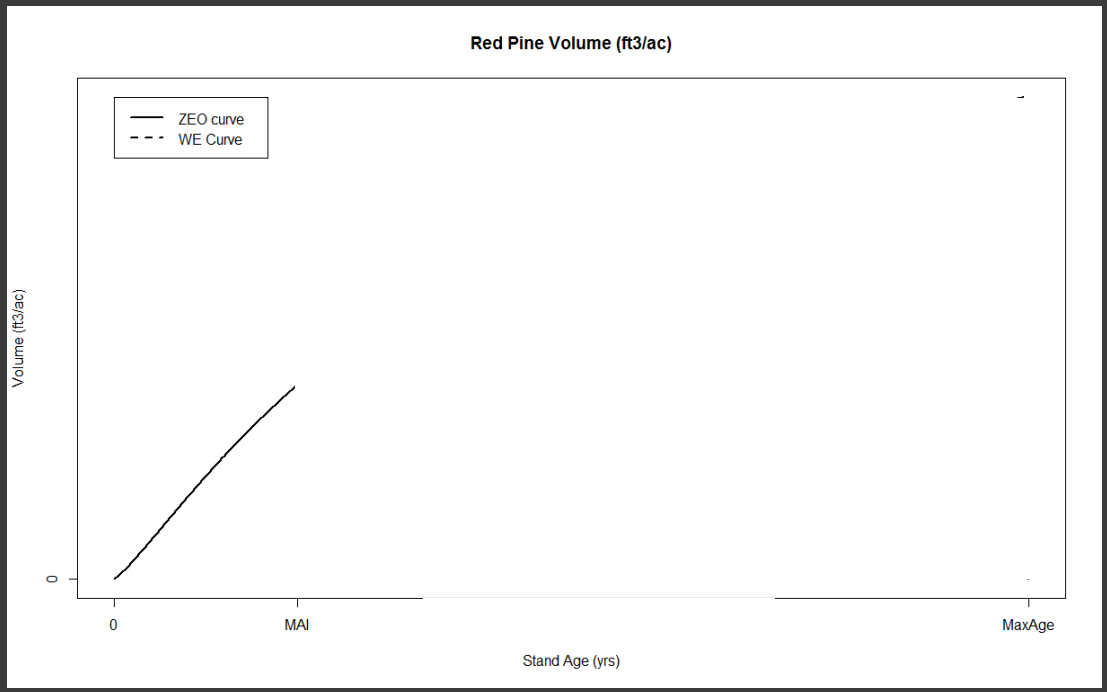
$MORTALITY_{volume} = WE_{volume} - ZEO_{volume}$

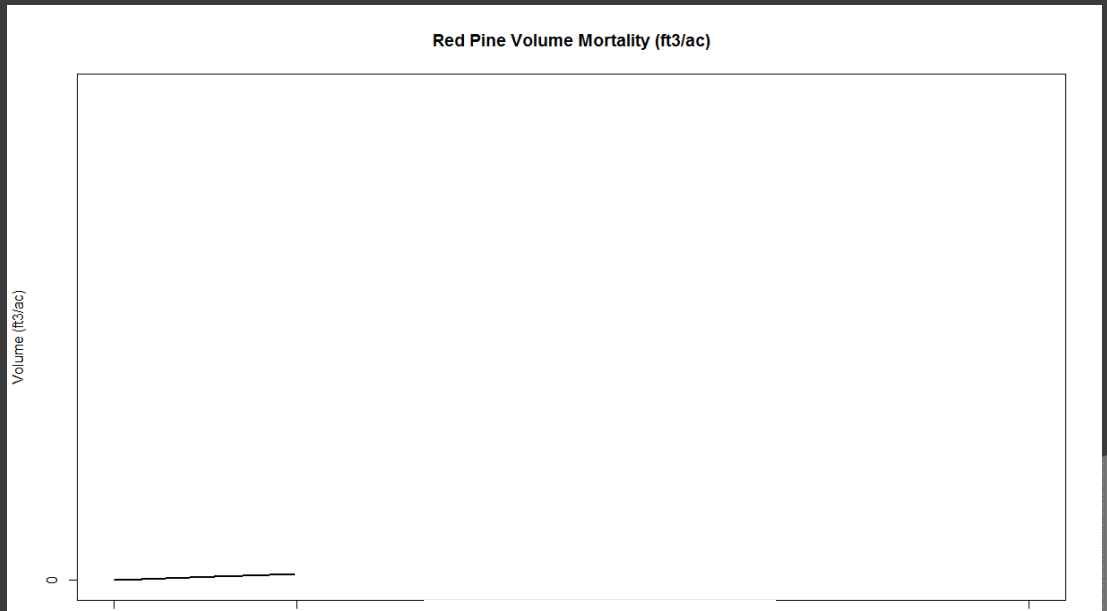
WE_{volume} :

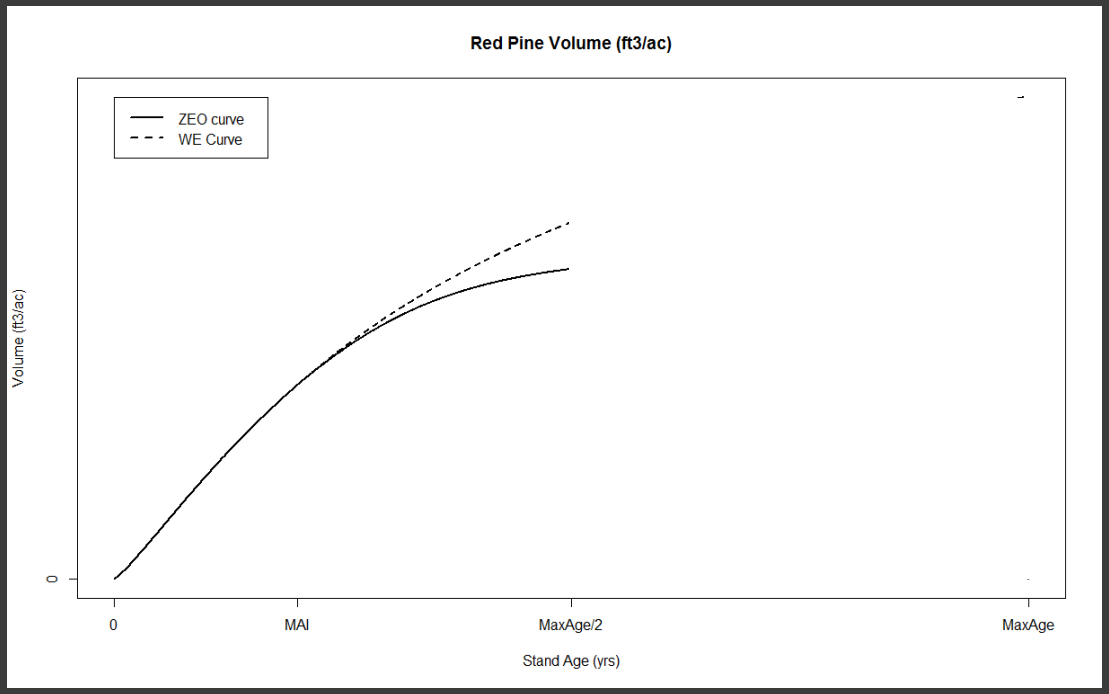
- Represents stand development without aging effects
- Constrained by maximum density (i.e., basal area maximum)
- Inherently incorporates mortality from original data

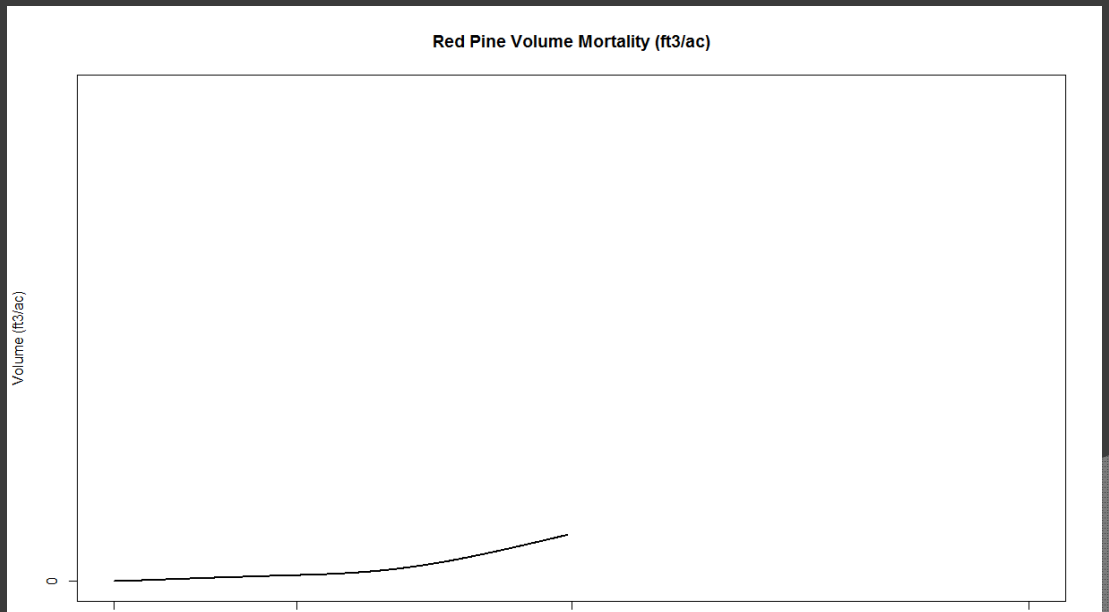
$MORTALITY_{volume}$:

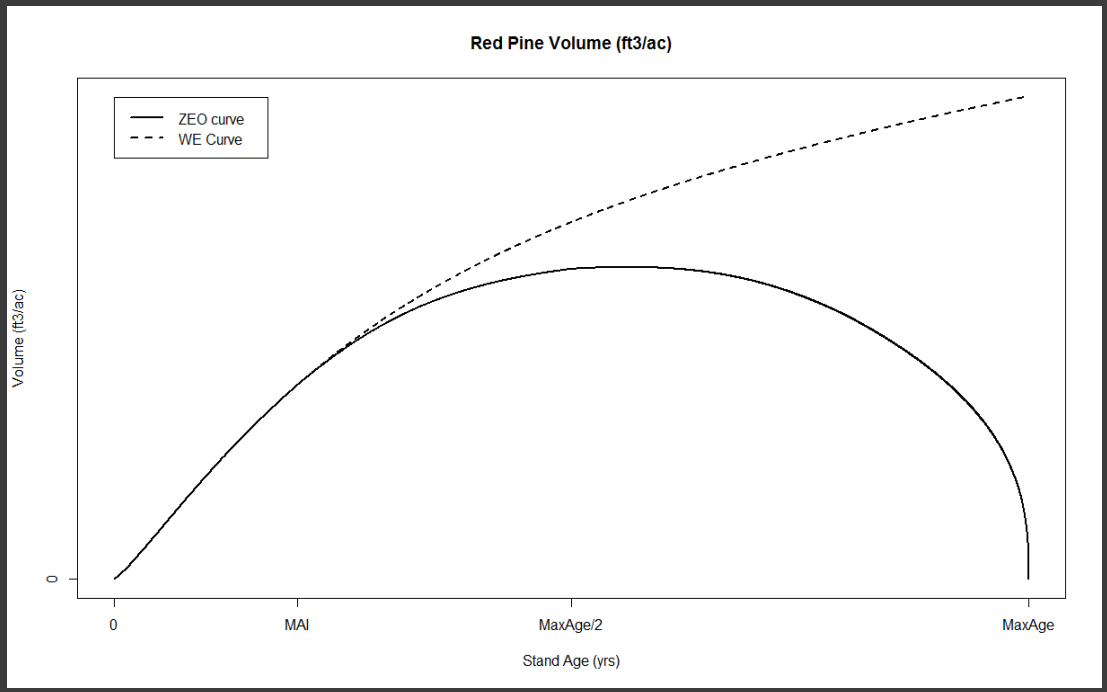
- Reflects empirical mortality until maximum Mean Annual Increment (MAI)
- Incrementally removes empirical mortality in favor of ZEO mortality until half maximum age
- Remainder of lifespan characterized by ZEO mortality

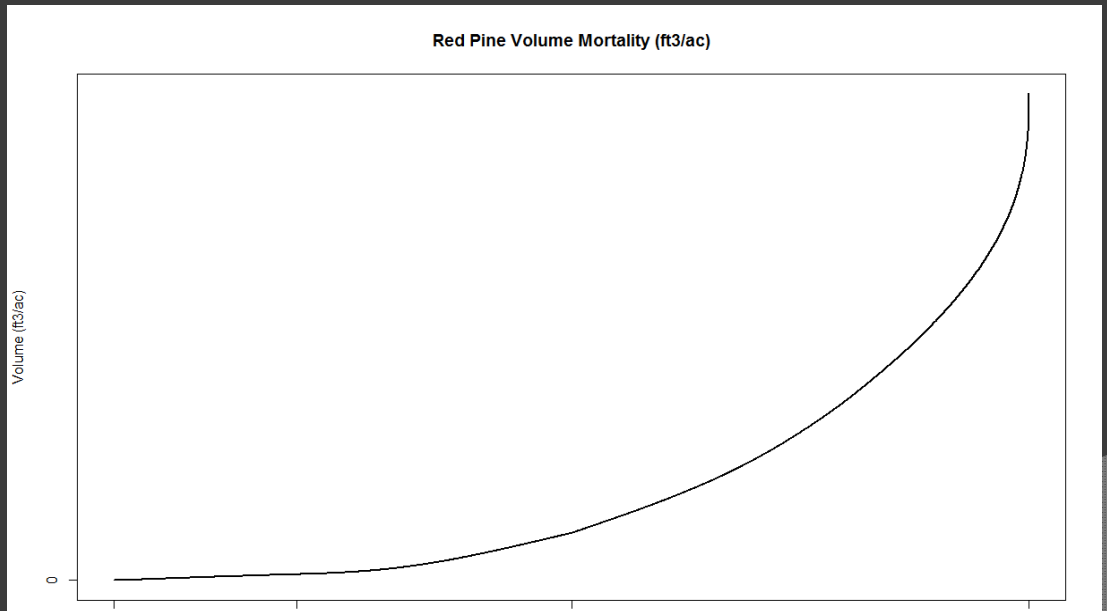

Red Pine Volume (ft3/ac)
ZEO curve
WE Curve
Volume (ft3/ac)
0
0
MAI
MaxAge
Stand Age (yrs)

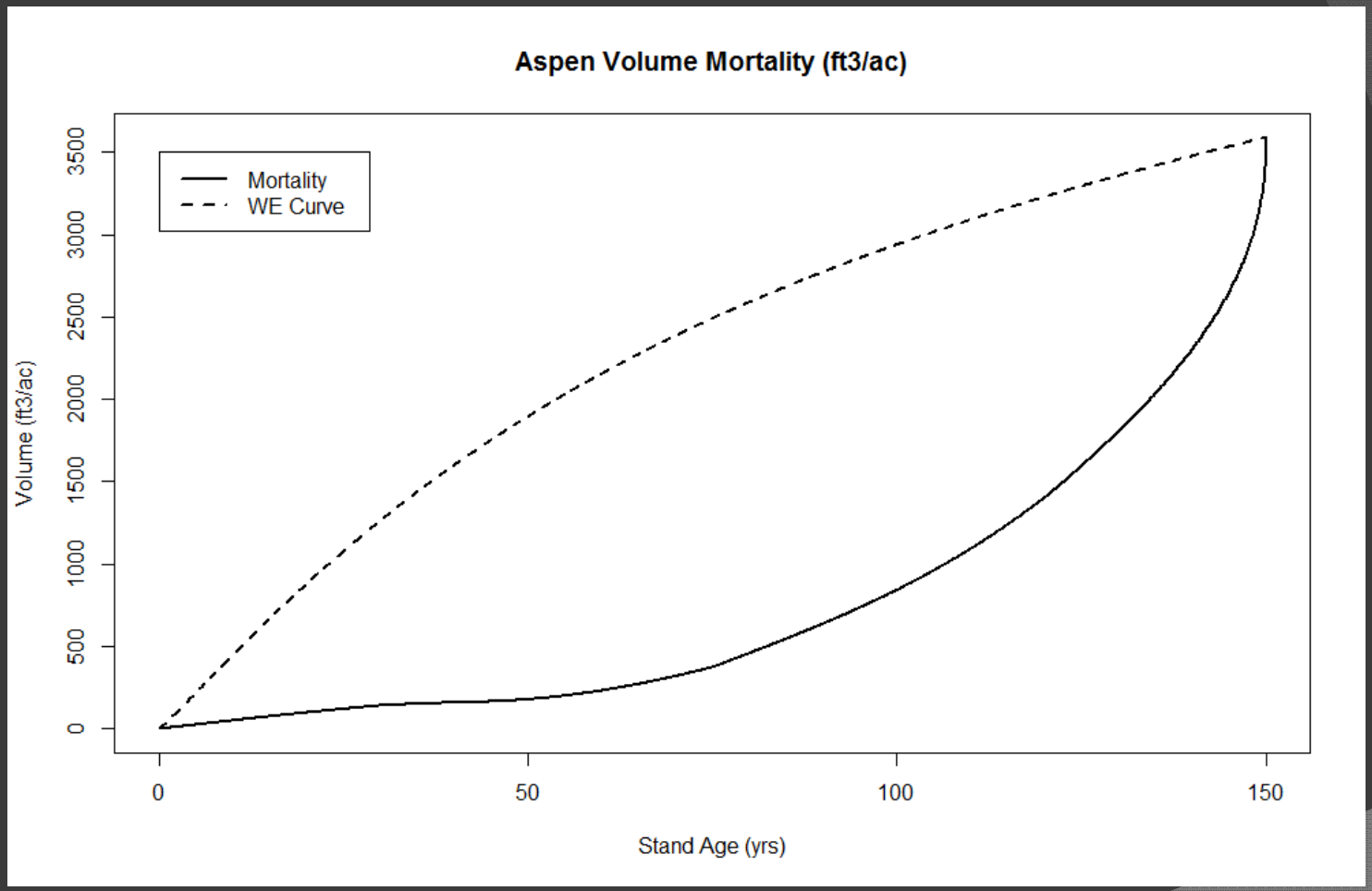

Red Pine Volume Mortality (ft3/ac)
Volume (ft3/ac)
0


Red Pine Volume (ft3/ac)
ZEO curve
WE Curve
Volume (ft3/ac)
0
0
MAI
MaxAge/2
MaxAge
Stand Age (yrs)


Red Pine Volume Mortality (ft3/ac)
Volume (ft3/ac)
0


Red Pine Volume (ft3/ac)
ZEO curve
WE Curve
Volume (ft3/ac)
0
0
MAI
MaxAge/2
MaxAge
Stand Age (yrs)


Red Pine Volume Mortality (ft3/ac)
Volume (ft3/ac)
0


Aspen Volume Mortality (ft3/ac)
Mortality
WE Curve
Volume (ft3/ac)
0
500
1000
1500
2000
2500
3000
3500
0
50
100
150
Stand Age (yrs)

Results in terms of Yield Tables

e 1. Red pine ZEO volume (cords/ac) and mortality (cords/ac) by age class (yrs). e corresponds to medium quality sites (Site Index = 65 ft), maximum age of 300 s, culminating MAI at 60 years, and declining yield after 160 years.

Age Class	Volume	Mortality	
20	12.5	0.4	
40	25.3	0.7	
60	36.2	1.1	Maximum MAI
80	44.7	1.6	
100	50.7	2.8	
120	54.7	4.9	
140	57.0	7.4	
160	58.1	10.7	Maximum Yield
180	58.0	14.8	
200	56.8	19.6	
220	53.9	25.7	
240	49.1	33.3	

eferences

Valters, D.K., and Ek, A.R. 1993. Whole stand yield and density equations for fourteen forest types in Minnesota. *North. J. Appl. For.* 10:75-85.

obel, J.M. 2013. A Whole Stand, Lifespan Yield Model for the Red Pine and Aspen Forest Types in Minnesota. *In*: Modeling forest growth, yield, and wildlife habitat in the Lake States. PhD Thesis. St. Paul, MN: University of Minnesota, Department of Forest Resources.

Any Questions?