Diameter Growth Equations for CONUS with Climate Variables

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Fit Diameter Growth Equations (no site index)

Preliminary CONUS-wide Diameter Growth Equation

We built a data set from Forest Inventory and Analysis (FIA) remeasurement data, filtering out observations with missing values for diameter at breast height (`dbh`), basal area in larger trees (`bal`), crown ratio (`cr`), total height (`ht`), site index (`si`), summer precipitation (PPT_{sm}), extreme minimum temperature (`EMT`), and remeasurement intervals less than 5 years. We also restricted the data to species with ≥ 5000 observations.

The diameter growth equation fit to these data was:

$$\Delta dbh = e^{(\beta_0 + \beta_1 log(\frac{(dbh+1)^2}{(cr*ht+1)^{\beta_4}}) + \beta_2 \frac{bal^{\beta_5}}{dbh+2.7} + \beta_3 PPT_{sm} + \beta_6 EMT)} \tag{1}$$

where:

- dbh = diameter at breast height (inches)
- cr = crown ratio (fraction of total height)
- ht = total height (feet)
- bal = basal area in larger trees ($feet^2/acre$)
- PPT_{sm} = summer precipitation (mm)
- EMT = extreme minimum temperature ($^\circ C$)

Equation 1 was fit to each qualifying species using an integrated fitting approach and errors minimized were ending `dbh`. 94 species equations were estimated. Sample sizes ranged from 5134 to 342704 observations.

The graphs below show the range of parameter estimates divided into Conifer and Hardwood groups. The parameter estimates are remarkable stable across species.
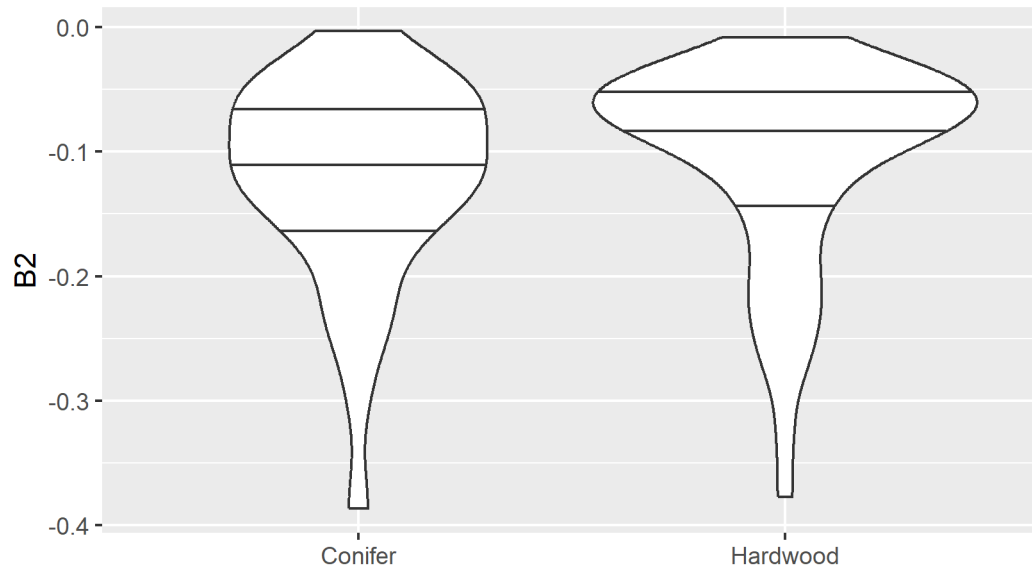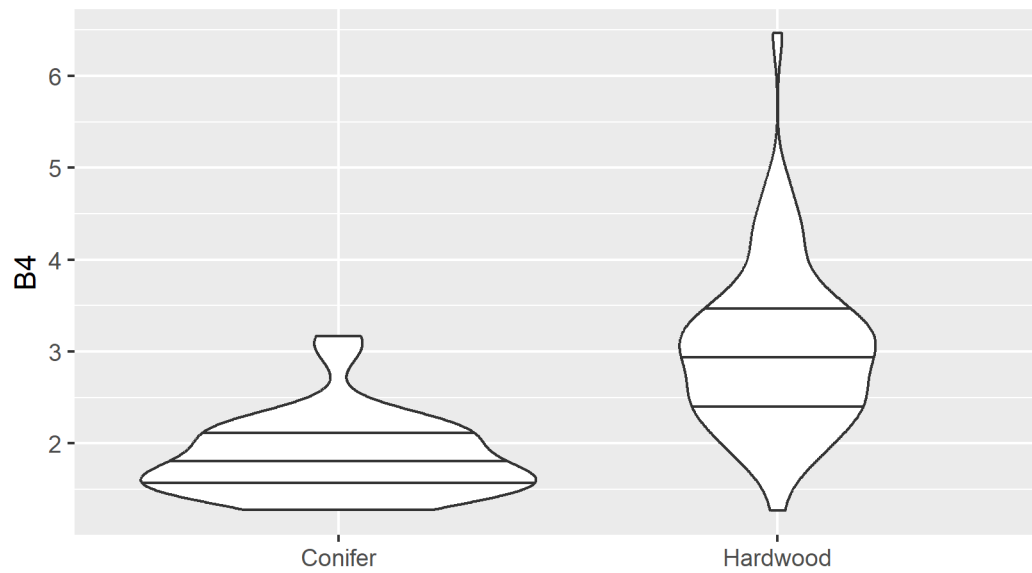
Sets Approximate Maximum DG

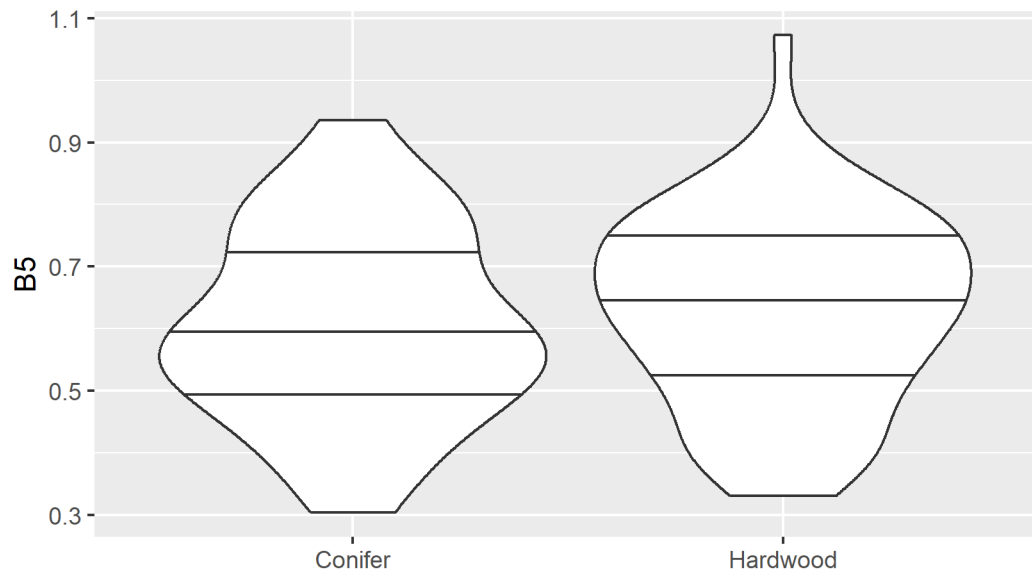## Sensitivity to Tree Size Relative to Crown

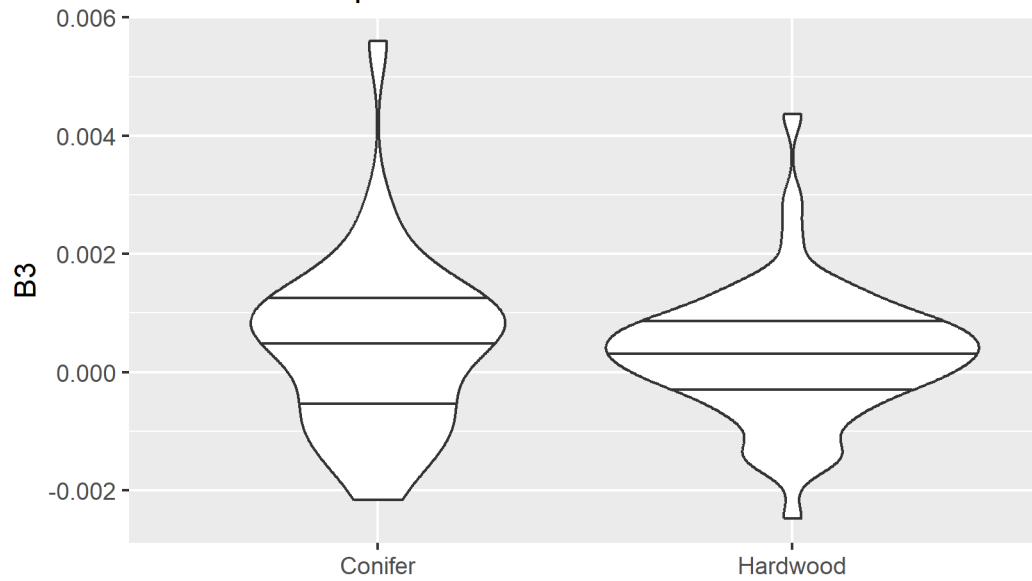## Sensitivity to Basal Area in Larger Trees Relative to DBH
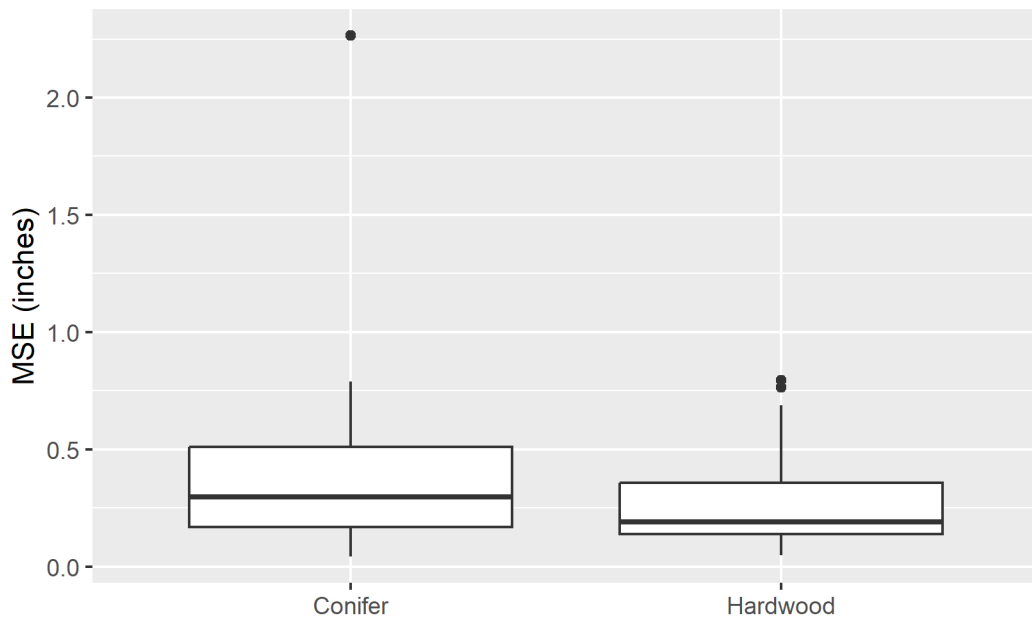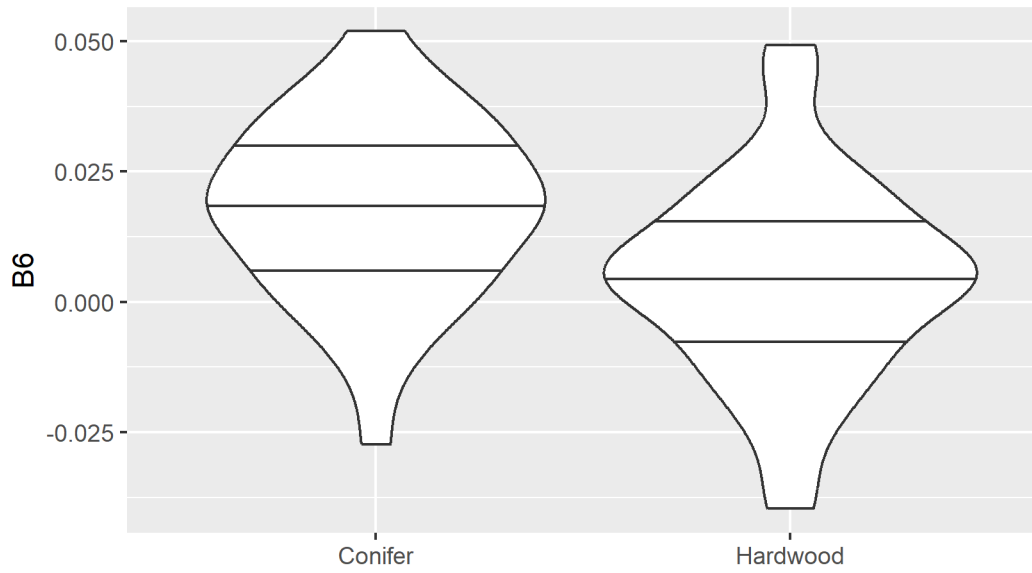

Adjusts Crown Effects

Adjusts Basal Area in Larger Trees Effects

Summer Precipitation Effects

4

Extreme Minimum Temperature Effects

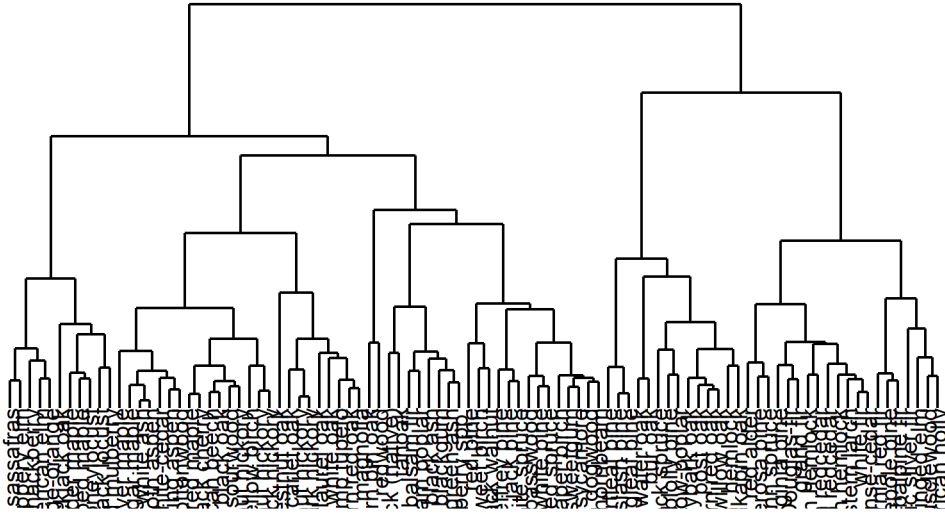# FIA Species Clusters by Diameter Growth Parameter Estimates

Table 1: Species with Negative Summer Precipitation Parameter

FIA Species Code	Common Name
131	loblolly pine
111	slash pine
621	yellow-poplar
827	water oak
110	shortleaf pine
108	lodgepole pine
835	post oak
832	chestnut oak
95	black spruce
68	eastern redcedar
261	eastern hemlock
19	subalpine fir
812	southern red oak
121	longleaf pine
820	laurel oak
711	sourwood
806	scarlet oak
71	tamarack (native)
403	pignut hickory
931	sassafras

FIA Species Code	Common Name
823	bur oak
407	shagbark hickory
831	willow oak
602	black walnut
402	bitternut hickory
824	blackjack oak
631	tanoak
813	cherrybark oak
826	chinkapin oak
552	honeylocust
682	red mulberry
20	California red fir

Table 2: Species with Negative Extreme Minimum Temperature Parameter

FIA Species Code	Common Name
131	loblolly pine
611	sweetgum
531	American beech
837	black oak
261	eastern hemlock
972	American elm
125	red pine
371	yellow birch
711	sourwood
409	mockernut hickory
105	jack pine
372	sweet birch
931	sassafras
313	boxelder maple
602	black walnut
462	hackberry
975	slippery elm
901	black locust
408	black hickory
402	bitternut hickory
824	blackjack oak
315	striped maple
826	chinkapin oak
641	Osage-orange

FIA Species Code	Common Name
552	honeylocust
682	red mulberry
116	Jeffrey pine