Appendix 9

Predicting basal area, volume and biomass from state and transition model age and structure attributes.

The data rollup process (see methods) appeared to be effective in assigning individual forest inventory plots (along with their forest structure data) to each vegetation state. However, we found that when states transitioned to other states (through succession, fire, partial harvest, etc.), the quantitative difference in forest structure (e.g., volume) between the pre-transition state (one inventory plot) and post-transition state (a different inventory plot) did not always make sense. For instance, a partial harvest would be expected to generate positive timber volume, but in some cases the post-transition volume was greater than the pre-transition volume, resulting in a negative harvest volume. To address this problem and all the plot-to-plot variability, we instead predicted forest structure attributes from regressions developed with data from the entire suite of 25,000-plus inventory plots in the study area. The plots were stratified by 41 combinations of PVT groups (similar PVTs) and dominant tree species (Table A6). Basal area, tree density (trees/ha), volume and biomass were regressed on forest characteristics described by the state and transition models: stand age, quadratic mean diameter, canopy cover, and number of canopy layers. We used proc glmselect (SAS Institute) with the lasso option for selecting the best models. The values assigned to each structure stage were calculated by multiplying the regression coefficients by the numeric equivalent of the size and canopy cover class midpoints for that structure stage. Age values for each structure stage were based on means from the inventory plots. The predictive equations met our objective of generating an expected trajectory of forest structure attributes across structure stages, that is, from small to large tree sizes, open to high canopy cover, and single- to multi-layered canopies. R-square values in the predictive equations ranged from 0.24 to 0.99, with median r-squares ranging from 0.66 to 0.88. The regression approach was not used for dead biomass due to poor model fit. Instead, we used the values from the rollup process for dead biomass.

Table A7. Adjusted r-squared values from best models of forest structure attributes regressed on stand age, quadratic mean diameter, canopy cover, and number of canopy layers. Attributes: sample size (N), total basal area (BA, m^2/ha), bole volume (VPH, m^3/ha), bole volume of trees 2.54-25 cm dbh (VPH3-25, m^3/ha), number of trees (TPH, trees/ha), number of trees $\geq$ 50 cm dbh (TPH50, trees/ha), and total biomass (Bio, Mg/ha).

PVT group	Cover type	N	BA	VPH	VPH3-25	TPH	TPH50	Bio
Mixed conifer – dry	Douglas-fir	371	0.89	0.90	0.70	0.73	0.65	0.90
	Douglas-fir/white fir	508	0.87	0.86	0.67	0.70	0.69	0.86
	ponderosa pine	1135	0.89	0.87	0.70	0.77	0.57	0.87
Mixed conifer – dry, pumice	ponderosa pine	1302	0.87	0.86	0.69	0.76	0.60	0.86
	white fir	533	0.85	0.85	0.67	0.72	0.71	0.85
Mixed conifer – cold, dry	Douglas-fir/white fir	36	0.87	*	*	0.69	0.73	*
	lodgepole pine	1356	0.87	0.85	0.69	0.79	0.58	0.85
	ponderosa pine	30	0.80	0.93	0.72	0.75	0.62	0.93
	white fir	629	0.87	0.86	0.66	0.65	0.68	0.86

Mixed conifer – cool, moist	Douglas-fir	439	0.87	0.89	0.66	0.72	0.43	0.89
	grand fir/Engelmann spruce	12	0.88	0.83	0.86	0.87	0.24	0.83
	ponderosa pine	1302	0.88	0.86	0.70	0.78	0.58	0.86
	red fir	63	0.97	0.96	0.84	0.86	0.85	0.96
	red fir/white fir	530	0.84	0.86	0.56	0.63	0.71	0.86
	western larch/lodgepole pine	39	0.79	0.81	0.55	0.81	*	0.81
	white fir	1049	0.88	0.88	0.63	0.63	0.69	0.88
White fir	Douglas-fir	426	0.86	0.84	0.62	0.65	0.69	0.84
	Douglas-fir/white fir	357	0.92	0.92	0.64	0.72	0.68	0.92
Ponderosa pine – dry	juniper	235	0.81	0.80	0.46	0.65	0.31	0.80
	ponderosa pine	2482	0.89	0.88	0.66	0.72	0.64	0.88
Ponderosa pine – xeric	juniper	409	0.82	0.78	0.52	0.69	0.55	0.78
	ponderosa pine	2528	0.90	0.89	0.69	0.74	0.63	0.89
Ponderosa - lodgepole	lodgepole pine	326	0.79	0.77	0.55	0.78	0.52	0.77
	ponderosa pine	771	0.89	0.90	0.69	0.76	0.69	0.90
	ponderosa pine/lodgepole pine	89	0.90	0.47	0.63	0.67	*	0.47
Lodgepole pine – dry	lodgepole pine	1347	0.89	0.90	0.63	0.69	0.71	0.90
Lodgepole pine – wet	lodgepole pine	984	0.86	0.88	0.43	0.71	0.71	0.88
Oak – Pine	oak-pine	352	0.91	0.92	0.70	0.74	0.68	0.92
	Oregon white oak	278	0.89	0.89	0.73	0.74	0.63	0.89
Western hemlock	Douglas-fir	921	0.89	0.89	0.62	0.67	0.73	0.89
	silver fir/Douglas-fir	700	0.91	0.91	0.62	0.67	0.75	0.91
Mountain hemlock	Engelmann spruce/subalpine fir	5	0.76	*	0.99	0.73	0.97	*
	grand fir	9	0.79	0.74	0.73	0.89	*	*
	lodgepole pine	711	0.87	0.86	0.69	0.77	0.57	0.86
	lodgepole pine/western larch	18	0.89	0.69	*	0.93	*	0.69
	mixed pine	338	0.77	0.77	0.59	0.74	0.61	0.77
	mountain hemlock	1665	0.89	0.88	0.63	0.62	0.68	0.88
	red fir	724	0.90	0.89	0.62	0.63	0.71	0.89
	western white pine	2	*	*	*	*	*	*
Subalpine parkland	subalpine parkland	630	0.88	0.89	0.59	*	0.74	0.89
	whitebark pine	15	0.65	0.87	0.70	0.59	0.88	0.87

** Equation was substituted from another comparable cover type due to poor model fit.*