Sampling Forest Stands for Foliar Nutrient Status

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Required number of Douglas-fir for estimating foliar nutrient concentration at varying levels of percent error (PE), probability that the confidence interval includes the true mean (α), and probability that the interval will be less than or equal to the desired width (β).

			1-α=0.95,1-β=0.95			1-α=0.90,1-β=0.90			1-α=0.90,1-β=0.50			1-α=0.75,1-β=0.50		
		PE:	±5%	±10%	±20%	±5%	±10%	±20%	±5%	±10%	±20%	±5%	±10%	±20%
Nutrient	df	CV (%)	Douglas-fir											
N	197	10.8	30	11	6	21	8	4	14	5	3	7	3	3
K	197	16.4	61	20	8	42	14	6	31	9	4	15	5	3
P	197	18.9	78	25	9	53	17	7	41	12	4	20	6	3
Ca	197	22.8	108	33	12	74	23	8	58	16	5	29	8	3
Mg	197	15.7	56	19	8	39	13	6	29	8	3	14	4	3
Mn	197	23.9	118	36	13	81	25	9	64	17	6	31	9	3
Fe	197	21.4	96	30	11	66	21	8	51	14	5	25	7	3
Zn	112	30	352	99	18	187	53	12	113	31	8	57	17	4
B	197	23.9	117	36	13	80	24	9	64	17	6	31	9	3
Cu	197	21	93	29	11	64	20	7	50	14	5	25	7	3
Mo	12	23.9	207	56	17	122	33	11	67	18	6	33	9	3
S	15	21.5	152	42	14	92	26	9	54	15	5	27	7	3
Al	18	31.8	305	81	24	187	50	15	116	30	9	57	15	4

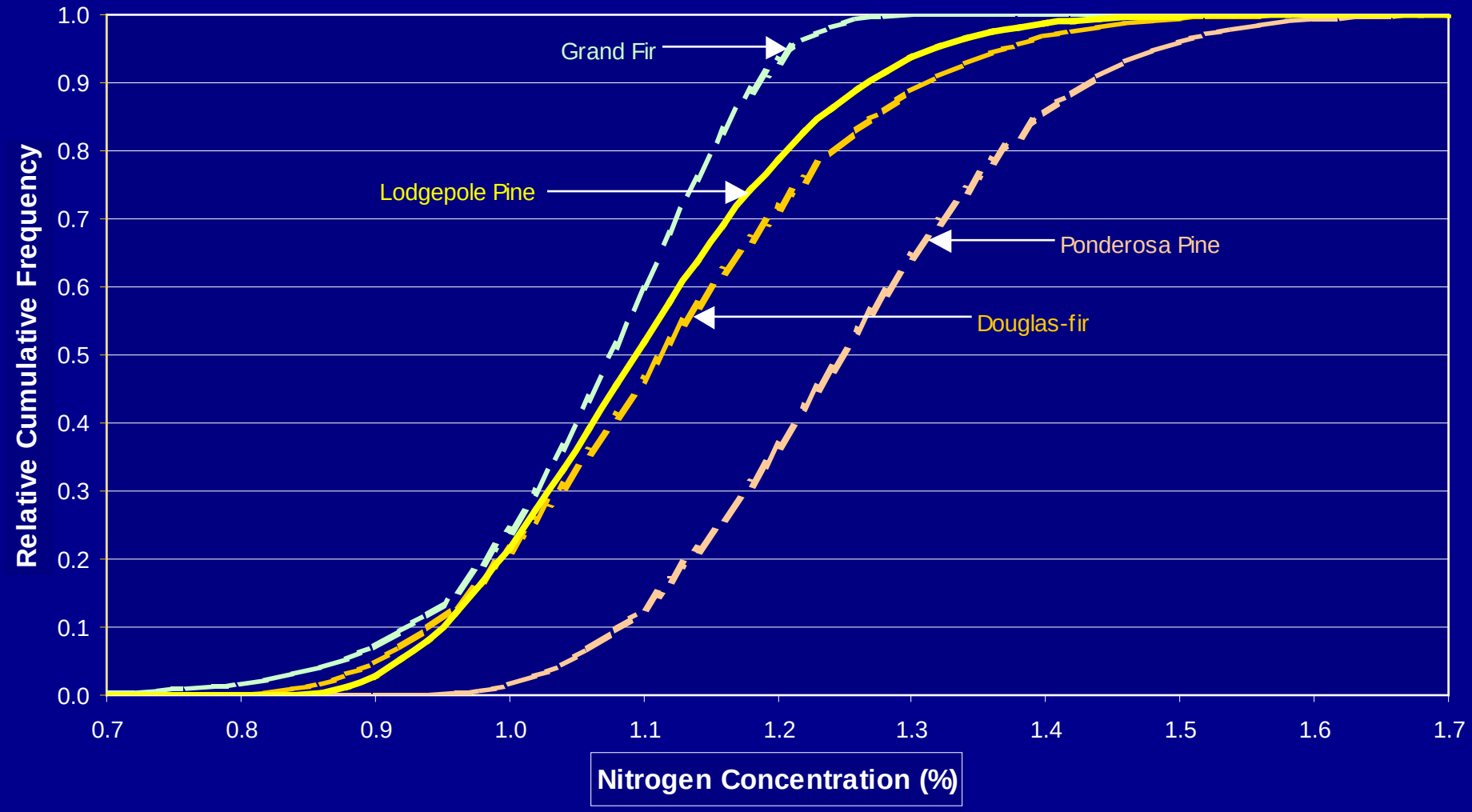
Calculations are based on the average coefficient of variation (CV) with its associated degrees of freedom (df).

Foliage weight and nutrient concentration percentiles for Douglas-fir.

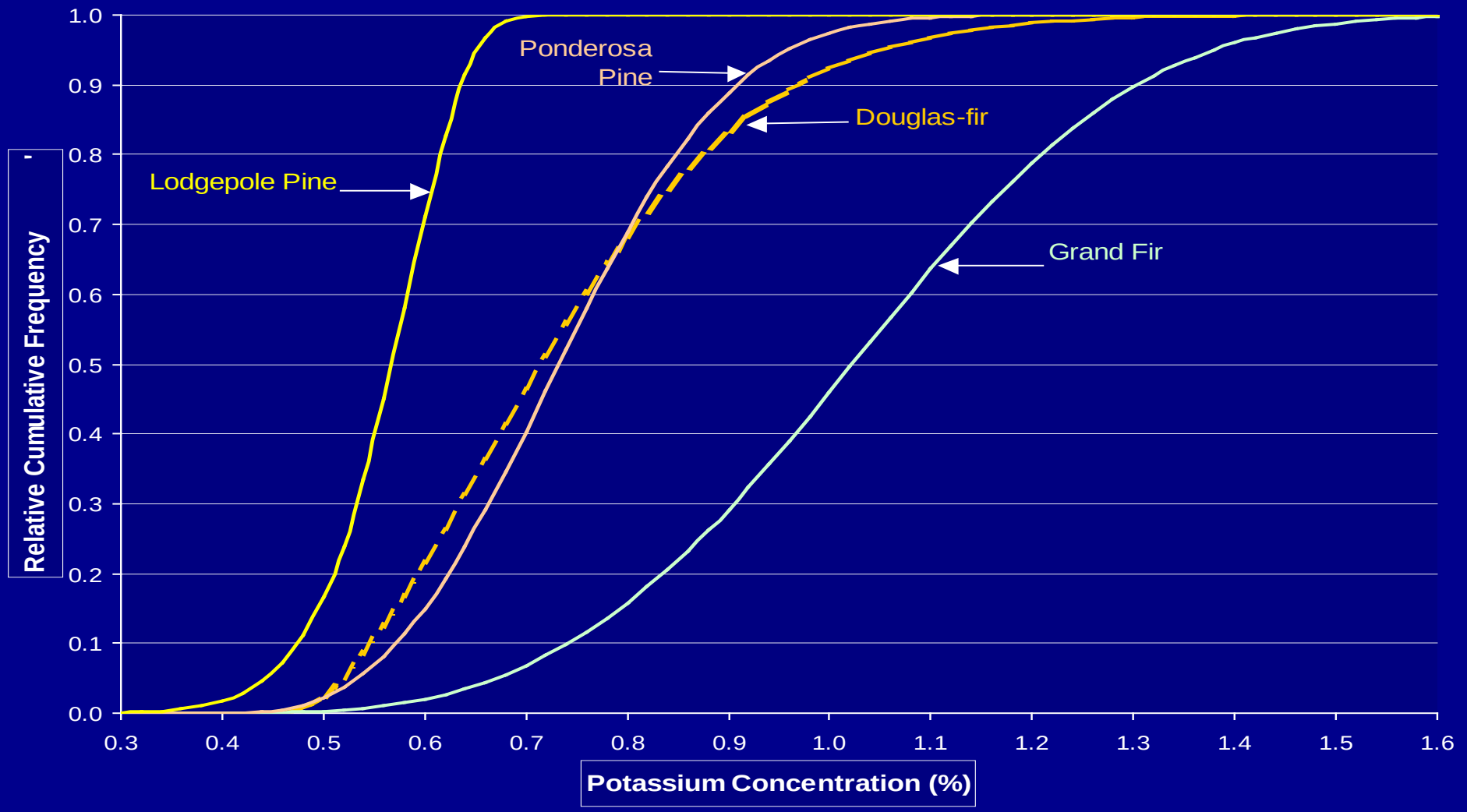
Percentile	Weight[a] (g)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Mn (ppm)	Fe (ppm)	Zn (ppm)	B (ppm)	Cu (ppm)	Mo (ppm)
5	0.446	0.902	0.152	0.519	0.042	0.272	0.085	68	24.7	19.3	16.7	1.83	0.17
10	0.479	0.941	0.164	0.548	0.052	0.290	0.092	101	30.4	21.0	18.0	2.08	0.22
20	0.523	0.995	0.179	0.594	0.064	0.316	0.103	151	38.8	23.4	20.0	2.46	0.30
30	0.557	1.038	0.191	0.635	0.073	0.337	0.114	195	45.9	25.3	21.7	2.78	0.36
40	0.587	1.076	0.201	0.674	0.080	0.358	0.124	237	52.5	27.0	23.2	3.09	0.42
50	0.615	1.113	0.210	0.715	0.087	0.378	0.135	280	59.1	28.7	24.8	3.39	0.47
60	0.644	1.152	0.220	0.759	0.094	0.399	0.148	325	66.0	30.5	26.4	3.72	0.53
70	0.675	1.193	0.230	0.810	0.102	0.423	0.162	377	73.8	32.5	28.3	4.08	0.59
80	0.712	1.242	0.241	0.873	0.110	0.453	0.181	441	83.2	34.8	30.6	4.53	0.66
90	0.763	1.311	0.257	0.968	0.122	0.495	0.210	536	96.9	38.1	33.8	5.18	0.76
95	0.804	1.368	0.269	1.051	0.131	0.531	0.235	618	108.5	40.9	36.6	5.74	0.84

[a] Foliage weight for 100 needles.

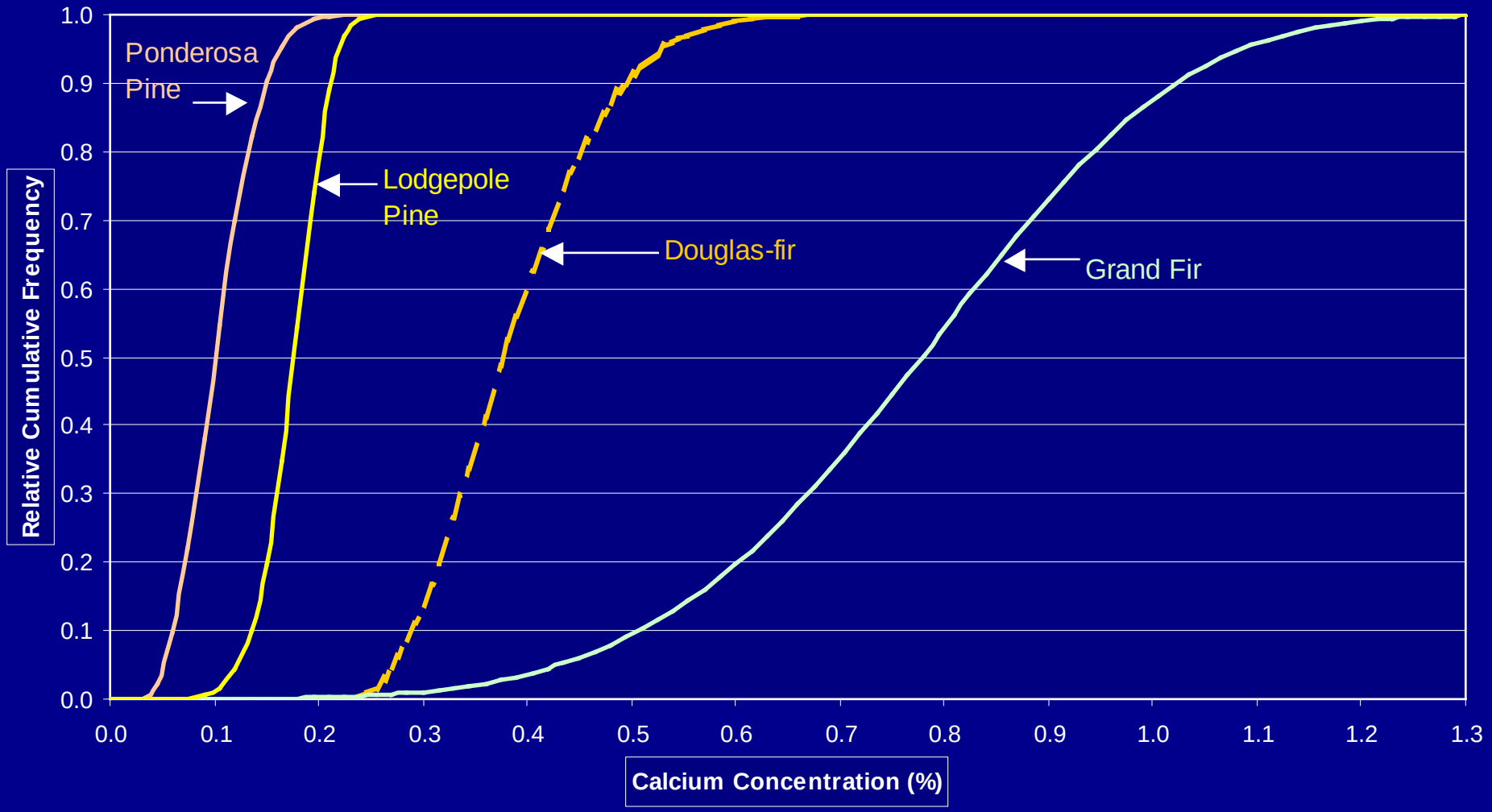
Foliar nitrogen concentration cumulative distributions for Douglas-fir, grand fir, ponderosa pine and lodgepole pine in the inland Northwest.



Foliar potassium concentration cumulative distributions for Douglas-fir, grand fir, ponderosa pine and lodgepole pine in the inland Northwest.



Foliar calcium concentration cumulative distributions for Douglas-fir, grand fir, ponderosa pine and lodgepole pine in the inland Northwest.



Summary

- For most situations, design your foliar nutrient sample size around the macro-nutrients and accept the less precise micro-nutrient estimates.
- Tree species show substantial differences in foliar nutrient concentrations.