

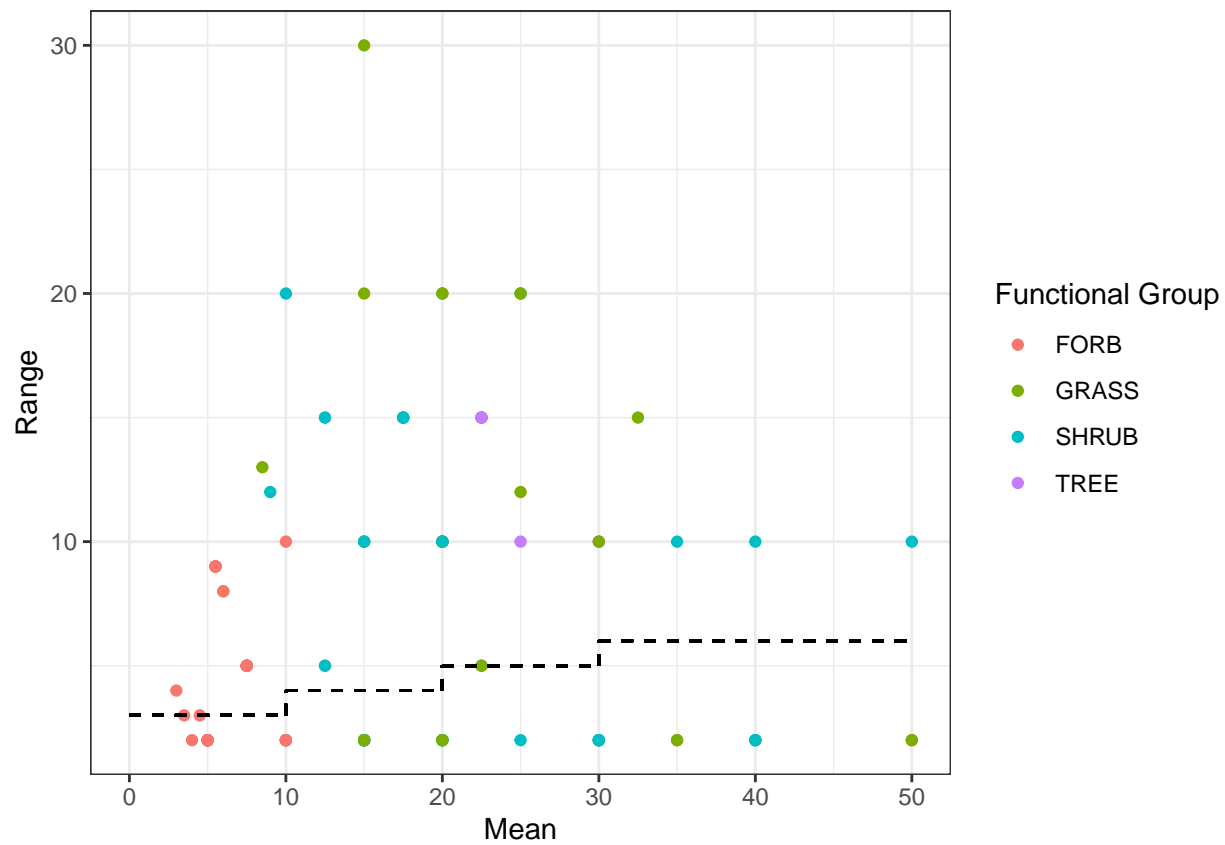
Increase Variation Around Narrow ESD Concepts

The quantitative benchmarks of ESDs are meant to capture the variation inherent in a state and phase under multiple conditions, from consecutive drought to surpluses of moisture, and following multiple disturbances (CITE). They are intended to capture the variation that would be found in this state and phase combination across the geographic and climatic extents of the ESD in the relevant MLRA. Some of the quantitative benchmarks, of the fractional cover of functional vegetation groups, for Ecological Sites which we collected from ESD's were very narrow. In many of these instances the reported values were more narrow than the uncertainty of the estimates of the true value of the population gleaned from a single AIM plot. It is apparent that several ESD developers did not emphasize the natural variability of the vegetation benchmarks while generating the cover estimates. This may be due to them only collecting quantitative vegetation data at a single site, and not across multiple time points, accordingly it seems in multiple instances they may only have had a point of datum, and did not feel comfortable estimate the variation in the system.

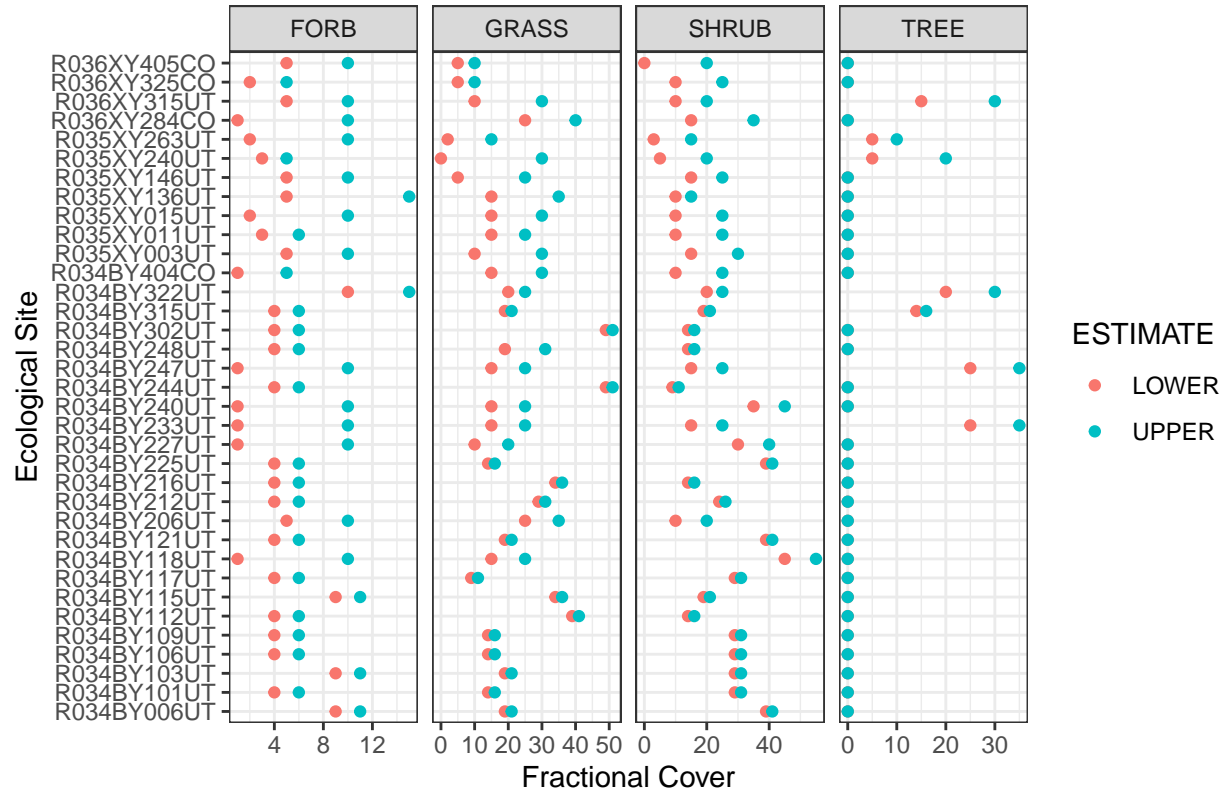
Well that approach is prudent, it is not prudent for us to assume such narrow ranges of variation. These may unduly penalize estimates of the amount of land under analysis which are meeting condition benchmarks. Here we seek to identify and broaden these estimates, we will use a simple method of *imputing* values in the context of *feature engineering*. A *linear model* will be fit to the benchmark values, which contain realistic ranges, and then the slope of this model will be used to fill in the missing values.

Ranges of estimated benchmark variation were estimated as being too low if they fell within the ranges in Table 1 & Figure 1 *top panel*. These XX values were removed from the initial data set. The remaining XX observations were used as **training** data for the linear models. Once the linear model was *fitted*, the removed data points had estimates of their values recorded.

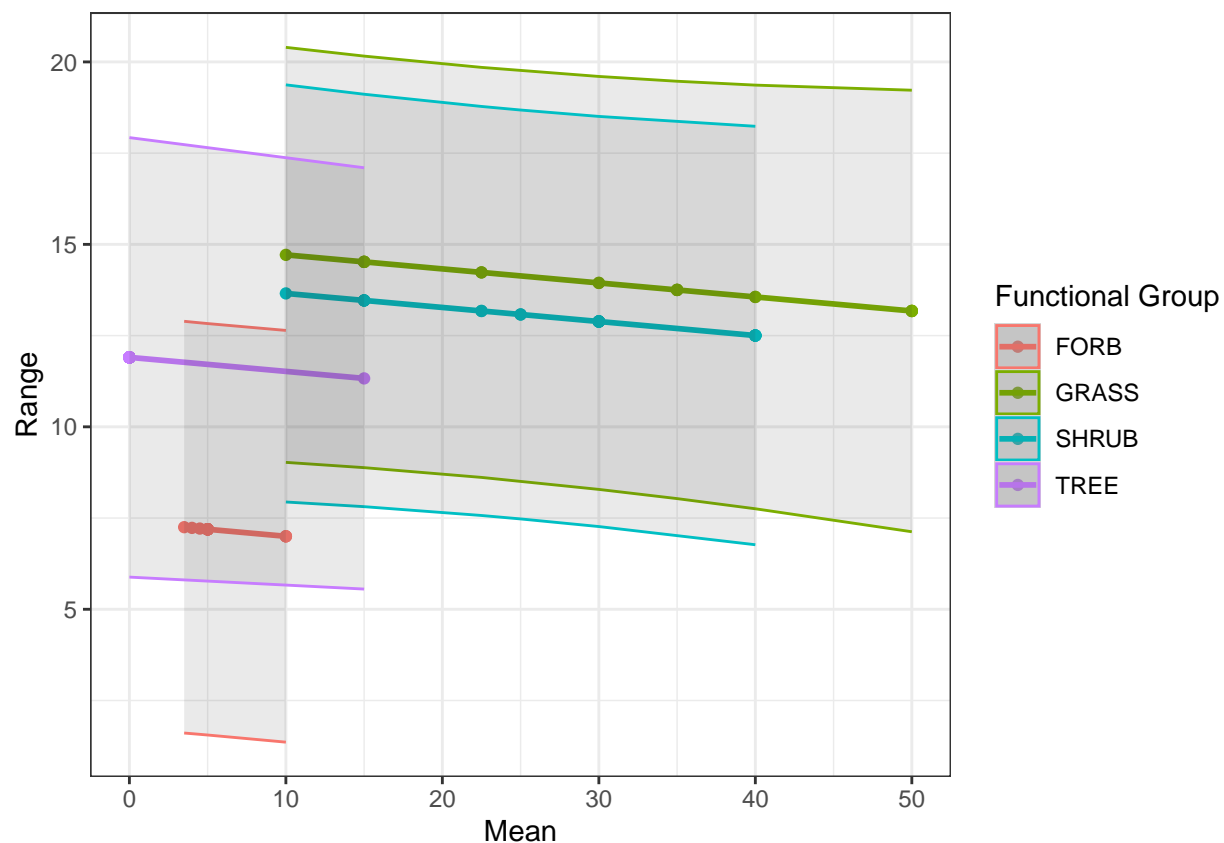
Mean	Range
< 10	< 3
10 - 20	< 4
20 - 30	< 5
30 - 50	< 6



Estimates of Ranges of Quantitative Benchmarks



$Range \sim Mean + \text{Functional Group}$



##	ECO.SITE	COVER_TYPE	RANGE	MEAN	ESTIMATE	COVER
## 1	R034BY322UT	SHRUB	13	22.5	LOWER	20
## 2	R034BY322UT	SHRUB	13	22.5	UPPER	25
## 3	R034BY322UT	GRASS	14	22.5	LOWER	20
## 4	R034BY322UT	GRASS	14	22.5	UPPER	25
## 5	R034BY006UT	SHRUB	13	40.0	LOWER	39
## 6	R034BY006UT	SHRUB	13	40.0	UPPER	41
## 7	R034BY109UT	SHRUB	13	30.0	LOWER	29
## 8	R034BY109UT	SHRUB	13	30.0	UPPER	31
## 9	R034BY117UT	SHRUB	13	30.0	LOWER	29
## 10	R034BY117UT	SHRUB	13	30.0	UPPER	31
## 11	R034BY106UT	SHRUB	13	30.0	LOWER	29
## 12	R034BY106UT	SHRUB	13	30.0	UPPER	31
## 13	R034BY112UT	GRASS	14	40.0	LOWER	39
## 14	R034BY112UT	GRASS	14	40.0	UPPER	41
## 15	R034BY302UT	GRASS	13	50.0	LOWER	49
## 16	R034BY302UT	GRASS	13	50.0	UPPER	51
## 17	R034BY212UT	SHRUB	13	25.0	LOWER	24
## 18	R034BY212UT	SHRUB	13	25.0	UPPER	26
## 19	R034BY212UT	GRASS	14	30.0	LOWER	29
## 20	R034BY212UT	GRASS	14	30.0	UPPER	31
## 21	R034BY244UT	GRASS	13	50.0	LOWER	49
## 22	R034BY244UT	GRASS	13	50.0	UPPER	51
## 23	R034BY101UT	SHRUB	13	30.0	LOWER	29
## 24	R034BY101UT	SHRUB	13	30.0	UPPER	31
## 25	R034BY103UT	SHRUB	13	30.0	LOWER	29

## 26	R034BY103UT	SHRUB	13	30.0	UPPER	31
## 27	R034BY121UT	SHRUB	13	40.0	LOWER	39
## 28	R034BY121UT	SHRUB	13	40.0	UPPER	41
## 29	R034BY115UT	GRASS	14	35.0	LOWER	34
## 30	R034BY115UT	GRASS	14	35.0	UPPER	36
## 31	R034BY216UT	GRASS	14	35.0	LOWER	34
## 32	R034BY216UT	GRASS	14	35.0	UPPER	36
## 33	R034BY225UT	SHRUB	13	40.0	LOWER	39
## 34	R034BY225UT	SHRUB	13	40.0	UPPER	41
## 35	R036XY325CO	TREE	12	0.0	LOWER	0
## 36	R036XY325CO	FORB	7	3.5	LOWER	2
## 37	R036XY284CO	TREE	12	0.0	LOWER	0
## 38	R034BY006UT	TREE	12	0.0	LOWER	0
## 39	R034BY006UT	FORB	7	10.0	LOWER	9
## 40	R034BY109UT	TREE	12	0.0	LOWER	0
## 41	R034BY109UT	GRASS	15	15.0	LOWER	14
## 42	R034BY109UT	FORB	7	5.0	LOWER	4
## 43	R034BY117UT	TREE	12	0.0	LOWER	0
## 44	R034BY117UT	GRASS	15	10.0	LOWER	9
## 45	R034BY117UT	FORB	7	5.0	LOWER	4
## 46	R034BY106UT	TREE	12	0.0	LOWER	0
## 47	R034BY106UT	GRASS	15	15.0	LOWER	14
## 48	R034BY106UT	FORB	7	5.0	LOWER	4
## 49	R034BY112UT	TREE	12	0.0	LOWER	0
## 50	R034BY112UT	SHRUB	13	15.0	LOWER	14
## 51	R034BY112UT	FORB	7	5.0	LOWER	4
## 52	R034BY302UT	TREE	12	0.0	LOWER	0
## 53	R034BY302UT	SHRUB	13	15.0	LOWER	14
## 54	R034BY302UT	FORB	7	5.0	LOWER	4
## 55	R036XY405CO	TREE	12	0.0	LOWER	0
## 56	R034BY212UT	TREE	12	0.0	LOWER	0
## 57	R034BY212UT	FORB	7	5.0	LOWER	4
## 58	R034BY248UT	TREE	12	0.0	LOWER	0
## 59	R034BY248UT	SHRUB	13	15.0	LOWER	14
## 60	R034BY248UT	FORB	7	5.0	LOWER	4
## 61	R034BY240UT	TREE	12	0.0	LOWER	0
## 62	R034BY244UT	TREE	12	0.0	LOWER	0
## 63	R034BY244UT	SHRUB	14	10.0	LOWER	9
## 64	R034BY244UT	FORB	7	5.0	LOWER	4
## 65	R034BY101UT	TREE	12	0.0	LOWER	0
## 66	R034BY101UT	GRASS	15	15.0	LOWER	14
## 67	R034BY101UT	FORB	7	5.0	LOWER	4
## 68	R034BY103UT	TREE	12	0.0	LOWER	0
## 69	R034BY103UT	FORB	7	10.0	LOWER	9
## 70	R034BY121UT	TREE	12	0.0	LOWER	0
## 71	R034BY121UT	FORB	7	5.0	LOWER	4
## 72	R034BY227UT	TREE	12	0.0	LOWER	0
## 73	R034BY115UT	TREE	12	0.0	LOWER	0
## 74	R034BY115UT	FORB	7	10.0	LOWER	9
## 75	R034BY315UT	TREE	11	15.0	LOWER	14
## 76	R034BY315UT	FORB	7	5.0	LOWER	4
## 77	R035XY015UT	TREE	12	0.0	LOWER	0
## 78	R035XY003UT	TREE	12	0.0	LOWER	0
## 79	R035XY011UT	TREE	12	0.0	LOWER	0

## 80	R035XY011UT	FORB	7	4.5	LOWER	3
## 81	R034BY216UT	TREE	12	0.0	LOWER	0
## 82	R034BY216UT	SHRUB	13	15.0	LOWER	14
## 83	R034BY216UT	FORB	7	5.0	LOWER	4
## 84	R034BY206UT	TREE	12	0.0	LOWER	0
## 85	R034BY225UT	TREE	12	0.0	LOWER	0
## 86	R034BY225UT	GRASS	15	15.0	LOWER	14
## 87	R034BY225UT	FORB	7	5.0	LOWER	4
## 88	R034BY118UT	TREE	12	0.0	LOWER	0
## 89	R035XY240UT	FORB	7	4.0	LOWER	3
## 90	R035XY146UT	TREE	12	0.0	LOWER	0
## 91	R035XY136UT	TREE	12	0.0	LOWER	0
## 92	R034BY404CO	TREE	12	0.0	LOWER	0
## ...93	R034BY322UT	TREE	10	25.0	LOWER	20
## ...94	R034BY322UT	TREE	10	25.0	UPPER	30
## ...95	R036XY284CO	SHRUB	20	25.0	LOWER	15
## ...96	R036XY284CO	SHRUB	20	25.0	UPPER	35
## ...97	R036XY284CO	GRASS	15	32.5	LOWER	25
## ...98	R036XY284CO	GRASS	15	32.5	UPPER	40
## ...99	R034BY248UT	GRASS	12	25.0	LOWER	19
## ...100	R034BY248UT	GRASS	12	25.0	UPPER	31
## ...101	R034BY240UT	SHRUB	10	40.0	LOWER	35
## ...102	R034BY240UT	SHRUB	10	40.0	UPPER	45
## ...103	R034BY227UT	SHRUB	10	35.0	LOWER	30
## ...104	R034BY227UT	SHRUB	10	35.0	UPPER	40
## ...105	R035XY015UT	GRASS	15	22.5	LOWER	15
## ...106	R035XY015UT	GRASS	15	22.5	UPPER	30
## ...107	R035XY003UT	SHRUB	15	22.5	LOWER	15
## ...108	R035XY003UT	SHRUB	15	22.5	UPPER	30
## ...109	R034BY233UT	TREE	10	30.0	LOWER	25
## ...110	R034BY233UT	TREE	10	30.0	UPPER	35
## ...111	R034BY247UT	TREE	10	30.0	LOWER	25
## ...112	R034BY247UT	TREE	10	30.0	UPPER	35
## ...113	R034BY206UT	GRASS	10	30.0	LOWER	25
## ...114	R034BY206UT	GRASS	10	30.0	UPPER	35
## ...115	R034BY118UT	SHRUB	10	50.0	LOWER	45
## ...116	R034BY118UT	SHRUB	10	50.0	UPPER	55
## ...117	R035XY136UT	GRASS	20	25.0	LOWER	15
## ...118	R035XY136UT	GRASS	20	25.0	UPPER	35
## ...119	R034BY404CO	GRASS	15	22.5	LOWER	15
## ...120	R034BY404CO	GRASS	15	22.5	UPPER	30
## ...121	R036XY315UT	TREE	15	22.5	LOWER	15
## ...122	R036XY315UT	TREE	15	22.5	UPPER	30
## ...123	R036XY325CO	SHRUB	15	17.5	LOWER	10
## ...124	R036XY325CO	GRASS	5	7.5	LOWER	5
## ...125	R034BY322UT	FORB	5	12.5	LOWER	10
## ...126	R036XY284CO	FORB	9	5.5	LOWER	1
## ...127	R036XY405CO	SHRUB	20	10.0	LOWER	0
## ...128	R036XY405CO	GRASS	5	7.5	LOWER	5
## ...129	R036XY405CO	FORB	5	7.5	LOWER	5
## ...130	R034BY240UT	FORB	9	5.5	LOWER	1
## ...131	R034BY227UT	GRASS	10	15.0	LOWER	10
## ...132	R034BY227UT	FORB	9	5.5	LOWER	1
## ...133	R035XY263UT	TREE	5	7.5	LOWER	5

##	...134	R035XY263UT	SHRUB	12	9.0	LOWER	3
##	...135	R035XY263UT	GRASS	13	8.5	LOWER	2
##	...136	R035XY263UT	FORB	8	6.0	LOWER	2
##	...137	R035XY015UT	SHRUB	15	17.5	LOWER	10
##	...138	R035XY015UT	FORB	8	6.0	LOWER	2
##	...139	R035XY003UT	FORB	5	7.5	LOWER	5
##	...140	R035XY011UT	SHRUB	15	17.5	LOWER	10
##	...141	R034BY233UT	FORB	9	5.5	LOWER	1
##	...142	R034BY247UT	FORB	9	5.5	LOWER	1
##	...143	R034BY206UT	SHRUB	10	15.0	LOWER	10
##	...144	R034BY206UT	FORB	5	7.5	LOWER	5
##	...145	R034BY118UT	FORB	9	5.5	LOWER	1
##	...146	R035XY240UT	TREE	15	12.5	LOWER	5
##	...147	R035XY240UT	SHRUB	15	12.5	LOWER	5
##	...148	R035XY240UT	GRASS	30	15.0	LOWER	0
##	...149	R035XY146UT	GRASS	20	15.0	LOWER	5
##	...150	R035XY146UT	FORB	5	7.5	LOWER	5
##	...151	R035XY136UT	SHRUB	5	12.5	LOWER	10
##	...152	R035XY136UT	FORB	10	10.0	LOWER	5
##	...153	R034BY404CO	SHRUB	15	17.5	LOWER	10
##	...154	R034BY404CO	FORB	4	3.0	LOWER	1
##	...155	R036XY315UT	SHRUB	10	15.0	LOWER	10
##	...156	R036XY315UT	FORB	5	7.5	LOWER	5