A Venerable Range Management Field Data Collection Technique Used to Develop Plant Community Cover and Frequency Characteristics Provides Unexpected New Levels of Detailed Species-specific Information

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The Line-point Transect …

- **Background**
- **Use and Enhancement**
- **Levels of Information**
  - Species-specific cover data
  - Associated plant community information
    - By canopy position and size
    - Other sample site characteristics
    - Associated abiotic landscape characteristics
  - Point feature specific information/relationships

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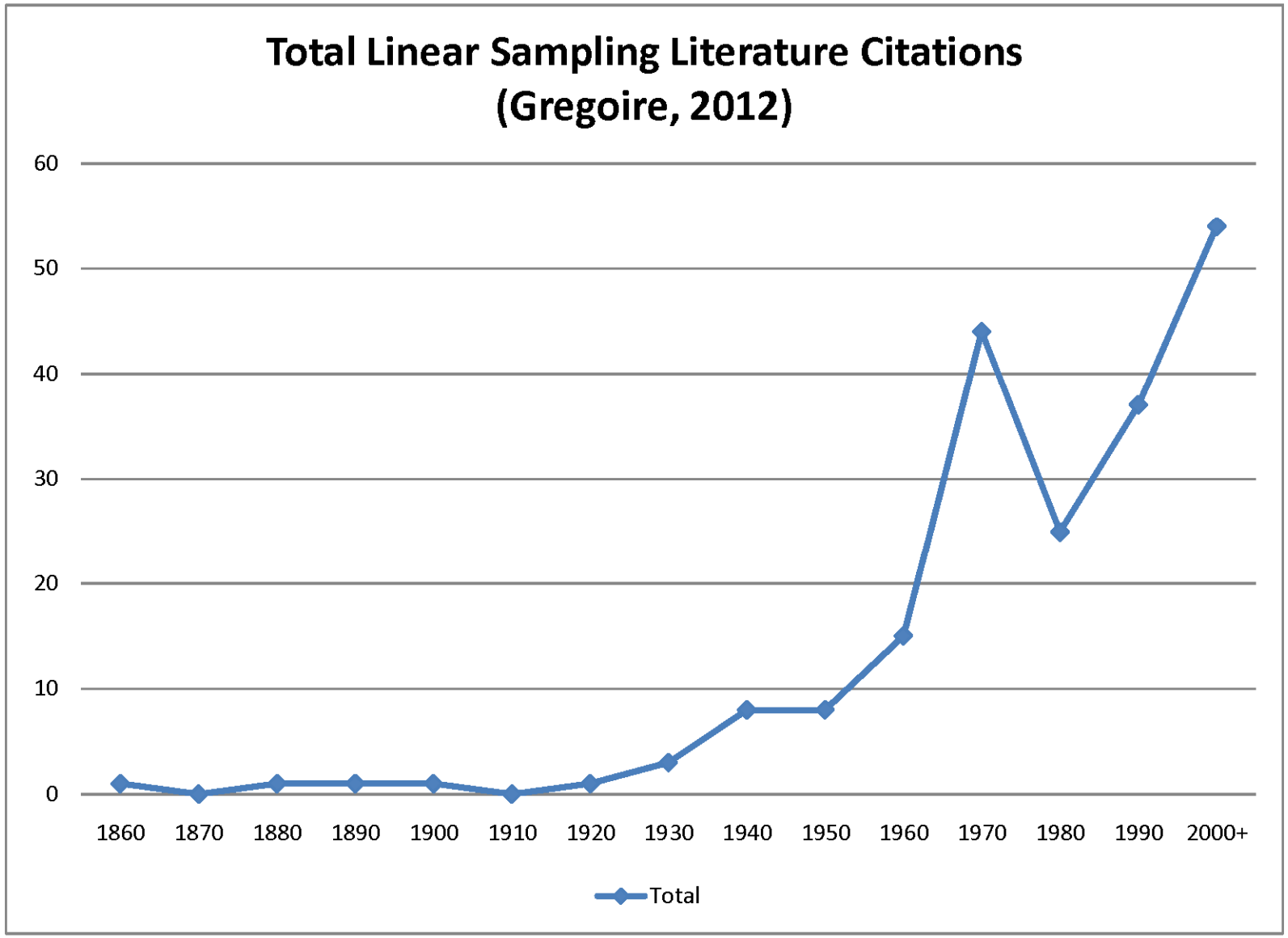
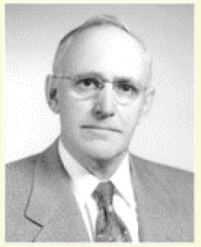

Total Linear Sampling Literature Citations
(Gregoire, 2012)
60
50
40
30
20
10
0
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000+
Total

Stumpf Line-point Transect Lineage

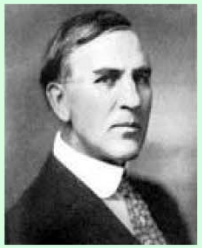


John E. Weaver

Plant Ecologist from 1916 - 1952

University of Minnesota

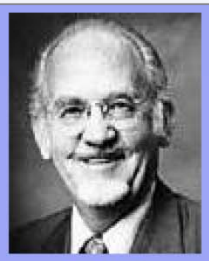
University of Nebraska



Frederic Clements

Pioneer Plant Ecologist from 1898 - 1941

University of Nebraska



Harold Heady

Range Ecologist from 1948 - 1982

University of Nebraska

UC Berkeley

UC Berkeley

Arnold Schultz

Plant Ecosystemologist 1949 - 1992

UC Berkeley

A.W. Sampson

First Range Ecologist from 1906 - 1952

UC Berkeley

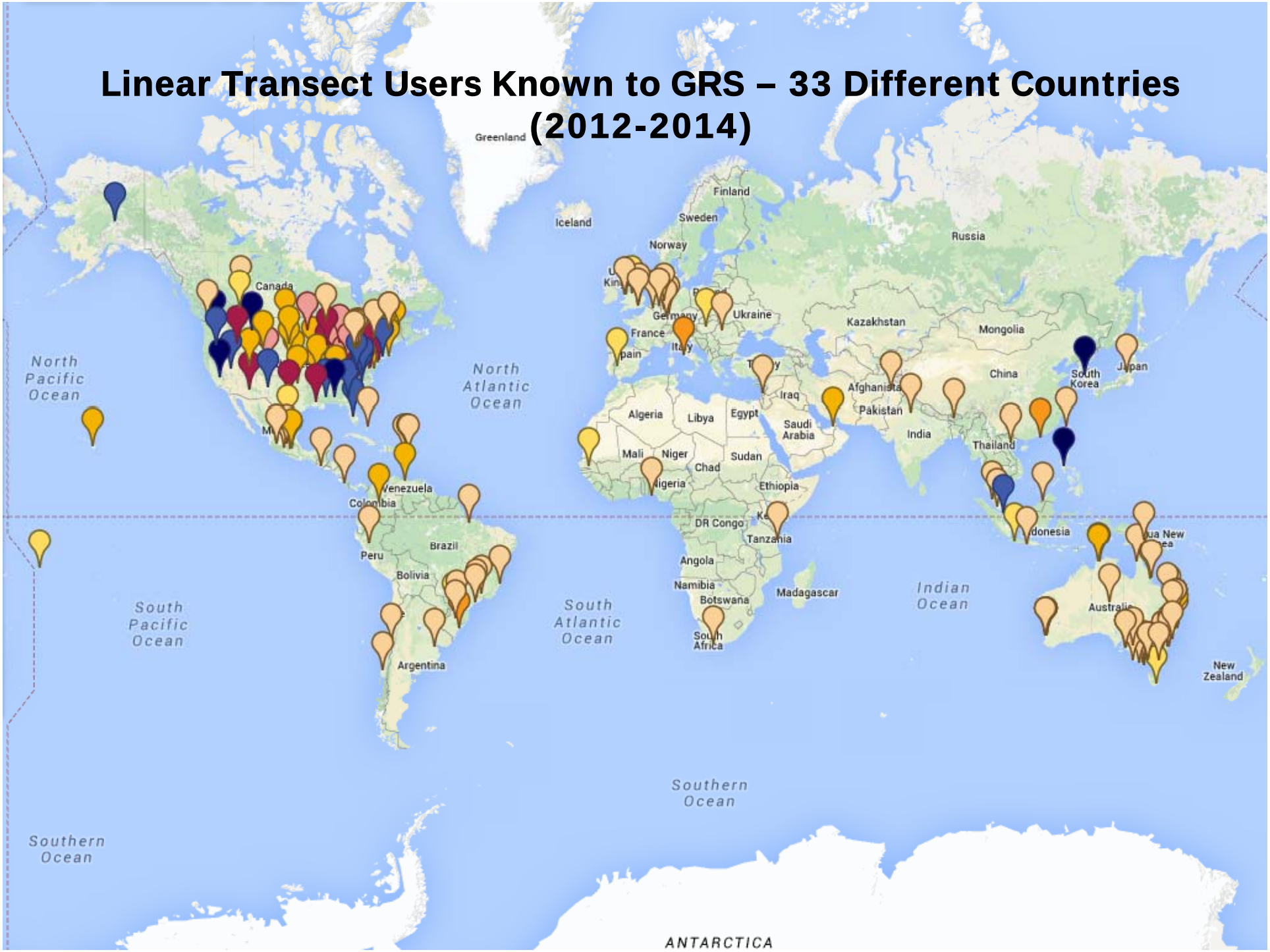
UC Berkeley

Ken Stumpf

Resource Modeler from 1975 - present

1898-2014

Linear Transect Users Known to GRS – 33 Different Countries (2012-2014)

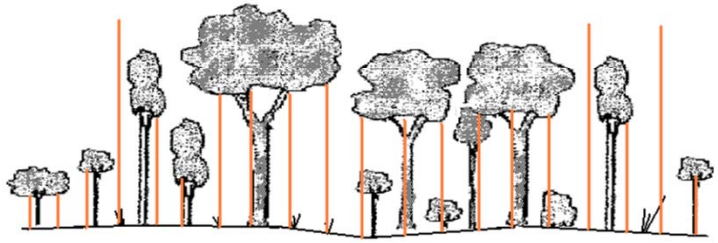


Use and Characteristics

- **Estimate**
  - %Cover by species/feature
  - Condition or Status
    - % Utilization
    - % Palatable
    - % Diseased or dead
- **Characteristics**
  - Fixed distance or interval between points
  - Vertical observation(s) at each point
  - Interval related to vegetation features

Sampling Enhancements

- **Record Point Characteristics**
  - Species
  - Status – living, stunted, or dead
  - Tree diameter
  - Crown diameter
  - Canopy position/layering
    - *4 layer designations for vegetation*
    - *1 layer designation for abiotic ground surface characteristics*
- **Integrate FireMon Woody Debris Transect Sampling**
  - Coarse and fine woody debris
- **Record "Trace" Species Observations**



Line-point Transect

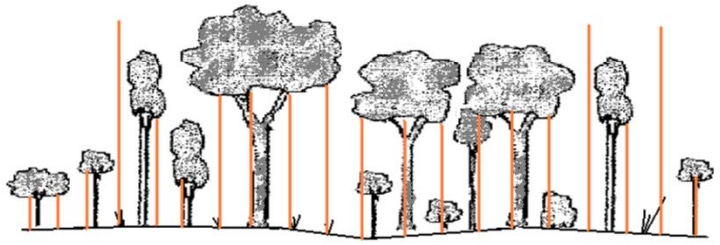
$$\%\text{cover} = \frac{\text{number of covered points}}{\text{total number of points}}$$

- **Layering**
  - Top/Dominant Trees
  - Overtopped Trees
  - Near ground Saplings/tall shrubs
  - On-the-ground shrubs/herbaceous
  - Ground surface condition

Sampling Enhancements

- **Vary interval distance with major lifeform**
  - 3 ft. for herbaceous plants
  - 6 ft. for shrubs
  - 9-15 ft. for trees
- **50-100 points**
- **Multiple transect configurations**
- **Total length =**

  interval * number of points

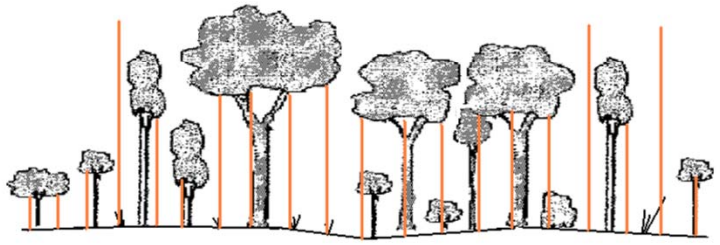


Line-point Transect

$$\%\text{cover} = \frac{\text{number of covered points}}{\text{total number of points}}$$

Sampling Enhancements

- **Capture transect data in the field**
  - Identify errors and correct
  - Output machine readable format
- **Record “type” observations**
- **Digital photography**
- **Capture GPS locations**
  - Do not transcribe
- **Process field results to provide feedback to field crew members**
  - Check “type” observations



Line-point Transect

$$\%\text{cover} = \frac{\text{number of covered points}}{\text{total number of points}}$$

Plant Community Sample Estimates

- **Quantitative cover estimates**
  - For each species
  - Total cover of all vegetation/landscape features
  - Ground Surface Condition
- **Cover statistics may be calculated**
  - Variance and standard deviation
  - Confidence limits
- **Tally number of species**
- **Identify “trace” species**

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Percent Cover Summary for All Layers:
Site/Polygon Id: 92203
Number of Sites: 1

Species	Tree Cover	Non-Tree Cover	Total Cover
Red fir	27.0		27.0
Red fir Dead	1.0		1.0
Mtn hemlock	25.0		25.0
Sierra currant		3.0	3.0
Pinemat manz		18.0	18.0
ELYELY		3.0	3.0
Achnath Occ		4.0	4.0
lichen		4.0	4.0
LUPOBT		3.0	3.0
MONODO		2.0	2.0
PENNEW		2.0	2.0
BarRoc		29.0	29.0
BarSGTA		20.0	20.0
FWD		6.0	6.0
CWD		4.0	4.0
LitDuf		41.0	41.0
Totals	**53.0**	**139.0**	**192.0**

Tree Cover Composition Summary for All Layers 53.0 Cover:

Species	Pct Total
Red fir	50.9
Red fir Dead	1.9
Mtn hemlock	47.2
Totals	100.0

Percent conifer composition = 100.0
Percent hardwood composition= 0.0
Most common specie is Red fir with 50.9 percent cover composition

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Site/Polygon Id: 92203
Number of Sites: 1

Percent Cover Summary for Top/Dominant Layer:

Species	Tree Cover	Non-Tree Cover	Total Cover
Red fir	20.0		20.0
Red fir Dead	1.0		1.0
Mtn hemlock	23.0		23.0
Totals	**44.0**	**0.0**	**44.0**

Percent Cover Summary for Over-Topped Layer:

Species	Tree Cover	Non-Tree Cover	Total Cover
Totals	**0.0**	**0.0**	**0.0**

Percent Cover Summary for Near Ground Pole/Sapling Layer:

Species	Tree Cover	Non-Tree Cover	Total Cover
Red fir	7.0		7.0
Mtn hemlock	2.0		2.0
Sierra currant		3.0	3.0
Totals	**9.0**	**3.0**	**12.0**

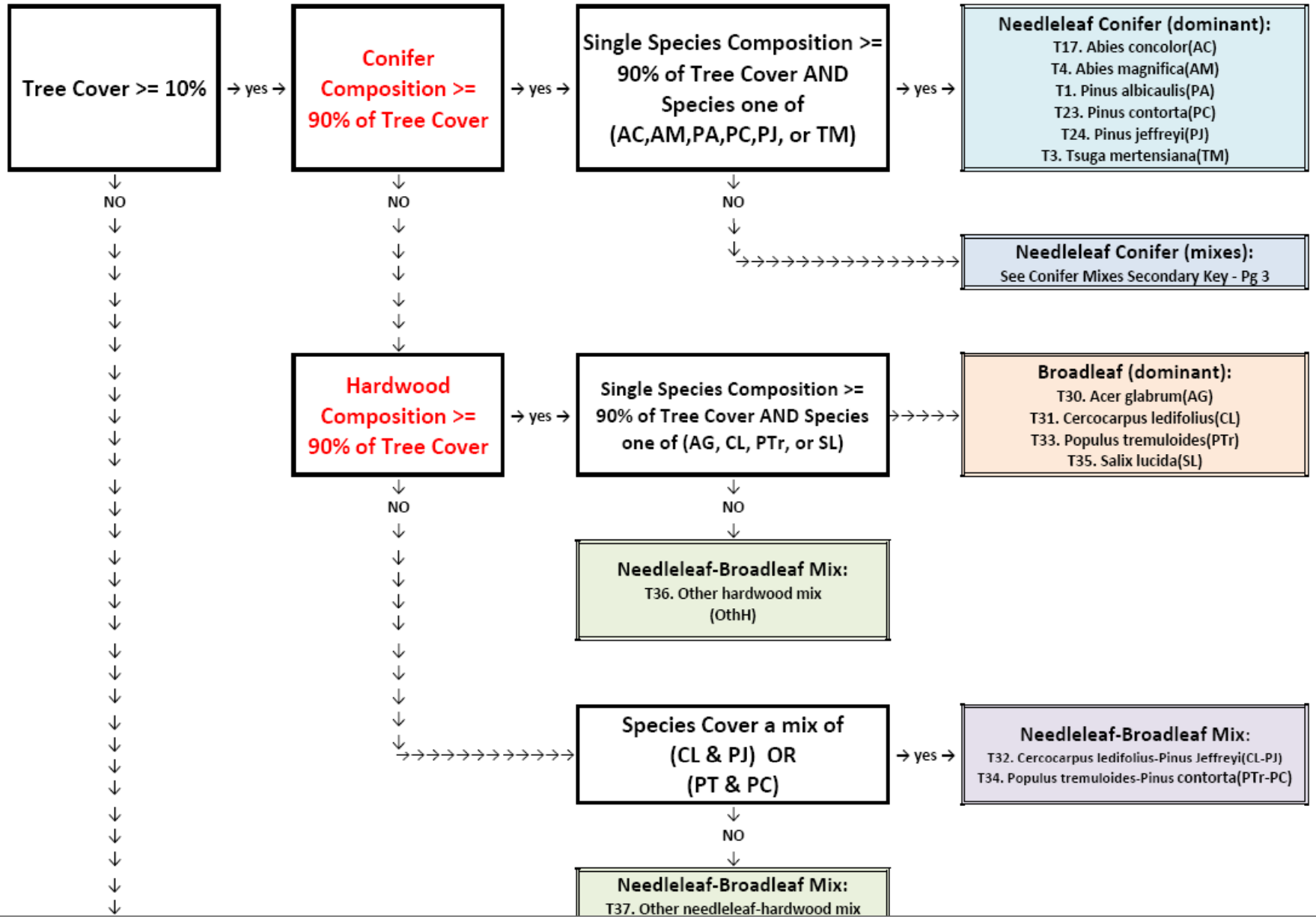
Percent Cover Summary for On-the-Ground Layer:

Species	Tree Cover	Non-Tree Cover	Total Cover
Pinemat manz		18.0	18.0
ELYELY		3.0	3.0
Achnath Occ		4.0	4.0
lichen		4.0	4.0
LUPOBT		3.0	3.0
MONODO		2.0	2.0
PENNEW		2.0	2.0
Totals	**0.0**	**36.0**	**36.0**

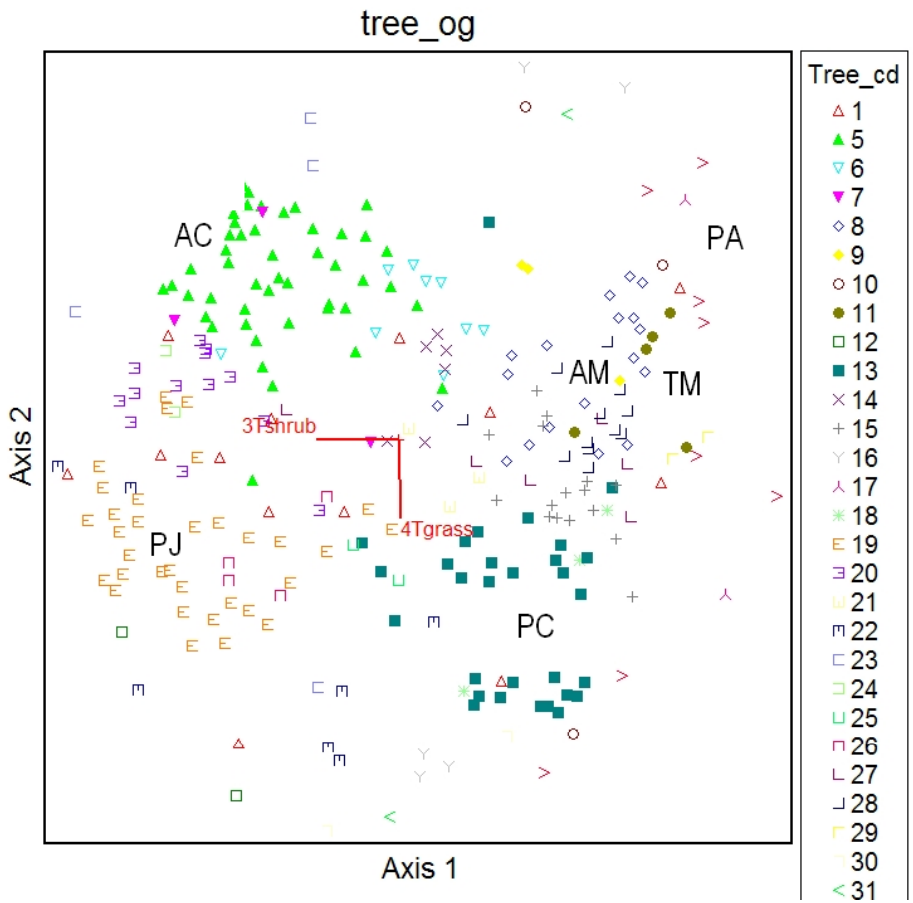
Percent Cover Summary for Ground Surface Condition Layer:

Species	Tree Cover	Non-Tree Cover	Total Cover
BarRoc		29.0	29.0
BarSGTA		20.0	20.0
FWD		6.0	6.0
CWD		4.0	4.0
LitDuf		41.0	41.0
Totals	**0.0**	**100.0**	**100.0**

LAVO Land Cover Alliance/Assoc. - Primary Key



Vegetation Classification and Descriptions



Type 538: *Abies magnifica-(Pinus monticola)-Tsuga mertensiana/ Arctostaphylos nevadensis* (Sparse) Woodland

Detailed Alliance Species	Total Frequency (%)	Total Average Cover	Total Minimum Cover	Total Maximum Cover
Tsuga mertensiana	100	11	2	25
Abies magnifica	80	16.8	2	37
Pinus monticola	40	3.6	8	10
Abies magnifica (dead)	20	0.2	1	1
Total tree		**31.6**		
Arctostaphylos nevadensis	100	26.8	4	77
Ribes nevadense	20	0.6	3	3
Holodiscus microphyllus	20	T	T	T
Ericameria bloomeri	20	T	T	T
Total shrub		**27.4**		
Lupinus obtusilobus	60	7.6	1	34
Elymus elymoides	40	0.6	3	3
Grass - other	40	0.6	3	3
Achnatherum species	20	1.2	6	6
Achnatherum occidentale	20	0.8	4	4
Rush - other	20	0.8	4	4
Carex species	20	0.4	2	2
Monardella odoratissima	20	0.4	2	2
Penstemon newberryi	20	0.4	2	2
Arabis platysperma	20	T	T	T
Total herbaceous		**12.8**		
Lichen	20	0.8	4	4
Total nonvascular		**0.8**		
Barren - litter	100	42.7	28	59
Barren - rock	100	19	3	34
Barren - duff	100	11.8	4	20
Barren - fine woody debris	100	8.5	4	14.5
Barren - fine gravelly soil	80	8	2	22
Barren - coarse woody debris	80	3.2	2	6
Barren - gravel	20	2	10	10
Barren - sand	20	2	10	10
Barren - bare soil	20	0.8	4	4
Barren - silty soil	20	0.2	1	1
Total other		**98.2**		
Totals		**170.8**		

A Second Level of Information

- **Generate "Bird's-eye" perspective**
  - Top down perspective, as though the dominant overstory vegetation obscures the understory from our view.
  - Evaluate layering of features and elevate each point's "topmost" feature to the "Bird's-eye" view perspective
  - Sum of "Bird's-eye" cover will total only 100%
  - Useful for mapping projects that involve photointerpretation and /or image classification as it attempts to describe just those features reflecting light back towards the sensor.

Site/Polygon Id: 92203
Number of Sites: 1

Percent Cover Summary for Top/Dominant Layer:

Species	Tree Cover	Non-Tree Cover	Total Cover
Red fir	20.0		20.0
Red fir Dead	1.0		1.0
Mtn hemlock	23.0		23.0
Totals	**44.0**	**0.0**	**44.0**

Percent Cover Summary for Over-Topped Layer:

Species	Tree Cover	Non-Tree Cover	Total Cover
Totals	**0.0**	**0.0**	**0.0**

Percent Cover Summary for Near Ground Pole/Sapling Layer:

Species	Tree Cover	Non-Tree Cover	Total Cover
Red fir	7.0		7.0
Mtn hemlock	2.0		2.0
Sierra currant		3.0	3.0
Totals	**9.0**	**3.0**	**12.0**

Percent Cover Summary for On-the-Ground Layer:

Species	Tree Cover	Non-Tree Cover	Total Cover
Pinemat manz		18.0	18.0
ELYELY		3.0	3.0
Achnath Occ		4.0	4.0
lichen		4.0	4.0
LUPOBT		3.0	3.0
MONODO		2.0	2.0
PENNEW		2.0	2.0
Totals	**0.0**	**36.0**	**36.0**

Percent Cover Summary for Ground Surface Condition Layer:

Species	Tree Cover	Non-Tree Cover	Total Cover
BarRoc		29.0	29.0
BarSGTA		20.0	20.0
FWD		6.0	6.0
CWD		4.0	4.0
LitDuf		41.0	41.0
Totals	**0.0**	**100.0**	**100.0**

Percent Cover Summary for Bird's-eye View:

Species	Tree Cover	Non-Tree Cover	Total Cover
Red fir	26.0		26.0
Red fir Dead	1.0		1.0
Mtn hemlock	23.0		23.0
Pinemat manz		10.0	10.0
ELYELY		3.0	3.0
Achnath Occ		4.0	4.0
lichen		4.0	4.0
LUPOBT		3.0	3.0
MONODO		2.0	2.0
BarRoc		10.0	10.0
BarSGTA		8.0	8.0
FWD		2.0	2.0
LitDuf		4.0	4.0
Totals	**50.0**	**50.0**	**100.0**

Type 538: *Abies magnifica-(Pinus monticola)-Tsuga mertensiana/Arctostaphylos nevadensis* (Sparse) Woodland

Detailed Alliance Species	Bird's-Eye Frequency (%)	Bird's-Eye Average Cover	Bird's-Eye Minimum Cover	Bird's-Eye Maximum Cover	Total Frequency (%)	Total Average Cover	Total Minimum Cover	Total Maximum Cover
Tsuga mertensiana	100	9.8	2	23	100	11	2	25
Abies magnifica	80	14.2	2	31	80	16.8	2	37
Pinus monticola	40	3.6	8	10	40	3.6	8	10
Abies magnifica (dead)	20	0.2	1	1	20	0.2	1	1
Total tree		27.8				31.6		
Arctostaphylos nevadensis	100	22.4	4	66	100	26.8	4	77
Ribes nevadense	P	P	P	P	20	0.6	3	3
Holodiscus microphyllus	T	T	T	T	20	T	T	T
Ericameria bloomeri	T	T	T	T	20	T	T	T
Total shrub		22.4				27.4		
Lupinus obtusilobus	60	7.2	1	32	60	7.6	1	34
Elymus elymoides	20	0.6	3	3	40	0.6	3	3
Grass - other	T	T	T	T	40	0.6	3	3
Achnatherum species	20	1.2	6	6	20	1.2	6	6
Achnatherum occidentale	20	0.8	4	4	20	0.8	4	4
Rush - other	20	0.4	2	2	20	0.8	4	4
Carex species	20	0.4	2	2	20	0.4	2	2
Monardella odoratissima	20	0.4	2	2	20	0.4	2	2
Penstemon newberryi	P	P	P	P	20	0.4	2	2
Arabis platysperma	T	T	T	T	20	T	T	T
Total herbaceous		11				12.8		
Lichen	20	0.8	4	4	20	0.8	4	4
Total nonvascular		**0.8**				**0.8**		
Barren - litter	100	11.4	2	29	100	42.7	28	59
Barren - rock	80	9.2	2	20	100	19	3	34
Barren - duff	80	7.2	2	16	100	11.8	4	20
Barren - fine woody debris	80	2.6	2	5	100	8.5	4	14.5
Barren - fine gravelly soil	80	4	2	12	80	8	2	22
Barren - coarse woody debris	40	1.6	2	6	80	3.2	2	6
Barren - gravel	20	1.2	6	6	20	2	10	10
Barren - sand	20	0.8	4	4	20	2	10	10
Barren - bare soil	P	P	P	P	20	0.8	4	4
Barren - silty soil	P	P	P	P	20	0.2	1	1
Total other		**38**				**98.2**		
Totals		**100**				**170.8**		

A Second Level of Information

- **Develop Cover by Size Estimates**
  - Define tree/shrub size (diameter/height) limits
  - Process tree/shrub size data to generate a summary of cover by species, layer, and size class.
  - Estimate relative species composition by size class.
  - Generate estimates of "canopy structure" based on the distribution of cover by canopy layers.
    - Even – significant cover is distributed primarily in two consecutive size classes.
    - Uneven – significant cover is distributed in three or more consecutive size classes.
    - Multi-storied – significant cover is distributed in two or more non-consecutive size classes.

Percent Cover Summary for All Layers:
Site/Polygon Id: 92203
Number of Sites: 1

Species	Dbh Size Class: <= 5.95"	> 5.95" <=11.95"	>11.95" <=17.95"	>17.95" <=29.95"	>29.95"	Tree Cover	Non-Tree Cover	Total Cover
Red fir	15.0	4.0	4.0	4.0	0.0	27.0		27.0
Red fir Dead	0.0	0.0	0.0	1.0	0.0	1.0		1.0
Mtn hemlock	8.0	7.0	10.0	0.0	0.0	25.0		25.0
Sierra currant							3.0	3.0
Pinemat manz							18.0	18.0
ELYELY							3.0	3.0
Achnath Occ							4.0	4.0
lichen							4.0	4.0
LUPOBT							3.0	3.0
MONODO							2.0	2.0
PENNEW							2.0	2.0
BarRoc							29.0	29.0
BarSGTA							20.0	20.0
FWD							6.0	6.0
CWD							4.0	4.0
LitDuf							41.0	41.0
Totals	**23.0**	**11.0**	**14.0**	**5.0**	**0.0**	**53.0**	**139.0**	**192.0**

Tree Cover Composition Summary for All Layers 53.0 Cover:

Species	Dbh Size Class: <= 5.95"	> 5.95" <=11.95"	>11.95" <=17.95"	>17.95" <=29.95"	>29.95"	All Sizes
Red fir	28.3	7.5	7.5	7.5	0.0	50.9
Red fir Dead	0.0	0.0	0.0	1.9	0.0	1.9
Mtn hemlock	15.1	13.2	18.9	0.0	0.0	47.2
Totals	**43.4**	**20.8**	**26.4**	**9.4**	**0.0**	**100.0**

Percent conifer composition= 100.0
Percent hardwood composition= 0.0
Most common specie is Red fir with 50.9 percent cover composition

A Second Level of Information(2)

- **Develop Other Stand Descriptive Information**
  - Generate species-specific estimates of Quadratic Mean Diameter (QMD).
  - Generate species-specific estimates of Quadratic Mean Crown Size (QMDCR).
  - Generate estimates of stems per unit area.
  - Generate estimates of percent mortality.
  - Generate estimates of biomass.

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Quadratic Mean DBH and TPA Summary for All Layers:
Site/Polygon Id: 92203
Number of Sites: 1
Weighted by Cover

Dbh Size Class: Species	<= 5.95"	> 5.95" <=11.95"	>11.95" <=17.95"	>17.95" <=29.95"	>29.95"	All Sizes
Red fir	3.2"	8.9"	15.0"	22.8"	0.0"	11.3"
cov_wt	15.0	4.0	4.0	4.0	0.0	27.0
tpa	963.9	28.4	15.7	28.2	0.0	1036.3
Red fir Dead	0.0"	0.0"	0.0"	23.0"	0.0"	23.0"
cov_wt	0.0	0.0	0.0	1.0	0.0	1.0
tpa	0.0	0.0	0.0	100.0	0.0	100.0
Mtn hemlock	4.3"	8.3"	14.4"	0.0"	0.0"	10.4"
cov_wt	8.0	7.0	10.0	0.0	0.0	25.0
tpa	106.9	61.9	81.0	0.0	0.0	249.7
	------	------	------	------	------	------
Conifer	3.6"	8.5"	14.6"	22.8"	0.0"	11.2"
cov_wt	23.0	11.0	14.0	5.0	0.0	53.0
tpa	1070.8	90.3	96.7	128.2	0.0	1386.0
	------	------	------	------	------	------
	------	------	------	------	------	------
All Species	**3.6"**	**8.5"**	**14.6"**	**22.8"**	**0.0"**	**11.2"**
cov_wt	**23.0**	**11.0**	**14.0**	**5.0**	**0.0**	**53.0**
tpa	**1070.8**	**90.3**	**96.7**	**128.2**	**0.0**	**1386.0**

A Second Level of Information(3)

- **Develop all of these plant community estimates**
  - for any recorded canopy layer
  - for the “Bird’s-eye” view

Percent Cover Summary for Bird's-eye Layer:
Site/Polygon Id: 92203
Number of Sites: 1

Dbh Size Class: Species	<= 5.95"	> 5.95" <=11.95"	>11.95" <=17.95"	>17.95" <=29.95"	>29.95"	Tree Cover	Non-Tree Cover	Total Cover
Red fir	14.0	4.0	4.0	4.0	0.0	26.0		26.0
Red fir Dead	0.0	0.0	0.0	1.0	0.0	1.0		1.0
Mtn hemlock	6.0	7.0	10.0	0.0	0.0	23.0		23.0
Pinemat manz							10.0	10.0
ELYELY							3.0	3.0
Achnath Occ							4.0	4.0
lichen							4.0	4.0
LUPOBT							3.0	3.0
MONODO							2.0	2.0
BarRoc							10.0	10.0
BarSGTA							8.0	8.0
FWD							2.0	2.0
LitDuf							4.0	4.0
Totals	20.0	11.0	14.0	5.0	0.0	50.0	50.0	100.0

Tree Cover Composition Summary for Bird's-eye Layer 50.0 Cover:

Dbh Size Class: Species	<= 5.95"	> 5.95" <=11.95"	>11.95" <=17.95"	>17.95" <=29.95"	>29.95"	All Sizes
Red fir	28.0	8.0	8.0	8.0	0.0	52.0
Red fir Dead	0.0	0.0	0.0	2.0	0.0	2.0
Mtn hemlock	12.0	14.0	20.0	0.0	0.0	46.0
Totals	**40.0**	**22.0**	**28.0**	**10.0**	**0.0**	**100.0**

Percent conifer composition= 100.0
Percent hardwood composition= 0.0
Most common specie is Red fir with 52.0 percent cover composition

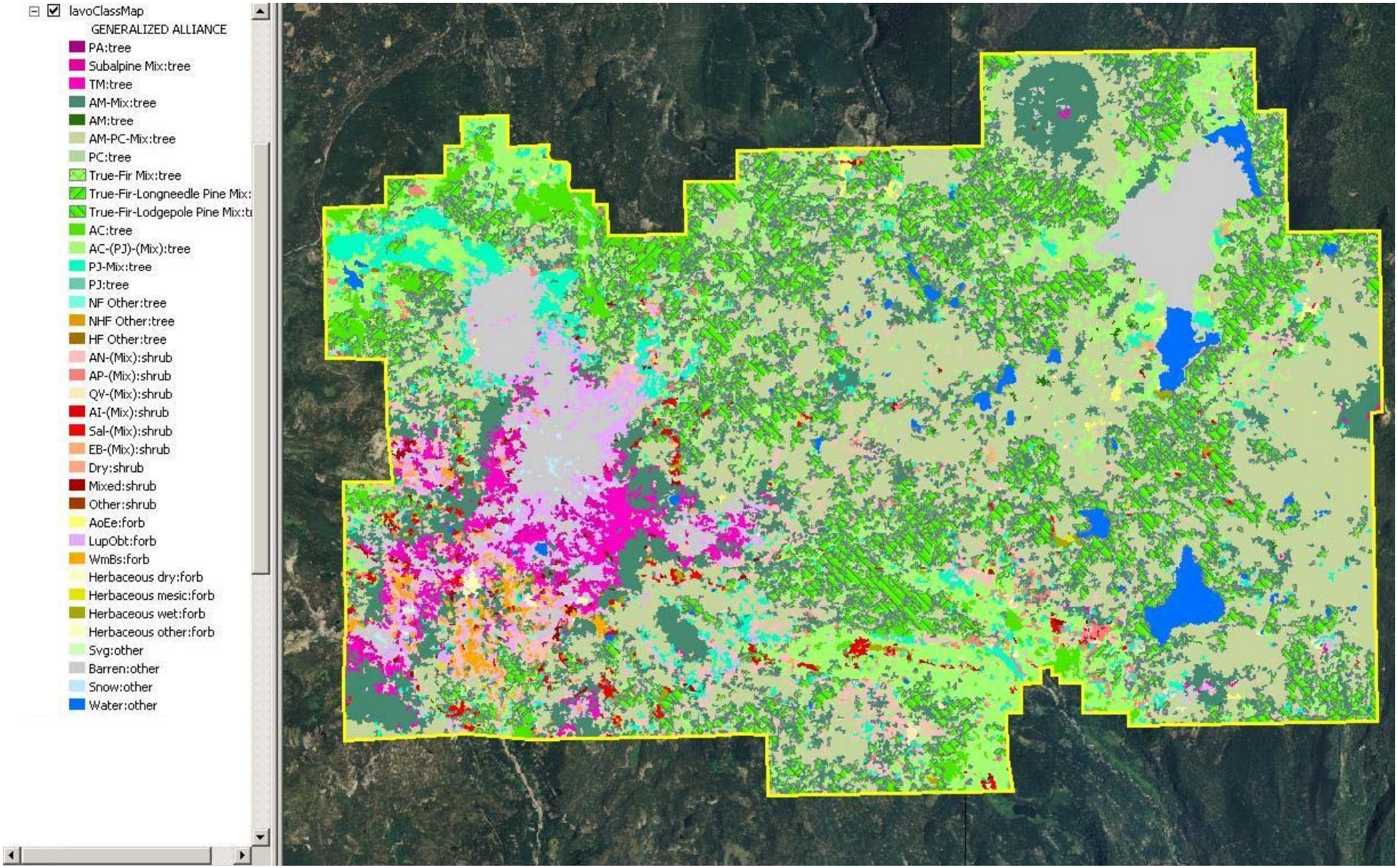
Quadratic Mean DBH and TPA Summary for Bird's-eye Layer:
Site/Polygon Id: 92203
Number of Sites: 1
Weighted by Cover

Dbh Size Class: Species	<= 5.95"	> 5.95" <=11.95"	>11.95" <=17.95"	>17.95" <=29.95"	>29.95"	All Sizes
Red fir	3.3"	8.9"	15.0"	22.8"	0.0"	11.5"
cov_wt	14.0	4.0	4.0	4.0	0.0	26.0
tpa	382.4	28.4	15.7	28.2	0.0	454.7
Red fir Dead	0.0"	0.0"	0.0"	23.0"	0.0"	23.0"
cov_wt	0.0	0.0	0.0	1.0	0.0	1.0
tpa	0.0	0.0	0.0	100.0	0.0	100.0
Mtn hemlock	5.0"	8.3"	14.4"	0.0"	0.0"	10.9"
cov_wt	6.0	7.0	10.0	0.0	0.0	23.0
tpa	76.1	61.9	81.0	0.0	0.0	218.9
	---	---	---	---	---	---
Conifer	3.9"	8.5"	14.6"	22.8"	0.0"	11.6"
cov_wt	20.0	11.0	14.0	5.0	0.0	50.0
tpa	458.5	90.3	96.7	128.2	0.0	773.6
	---	---	---	---	---	---
	---	---	---	---	---	---
All Species	**3.9"**	**8.5"**	**14.6"**	**22.8"**	**0.0"**	**11.6"**
cov_wt	**20.0**	**11.0**	**14.0**	**5.0**	**0.0**	**50.0**
tpa	**458.5**	**90.3**	**96.7**	**128.2**	**0.0**	**773.6**

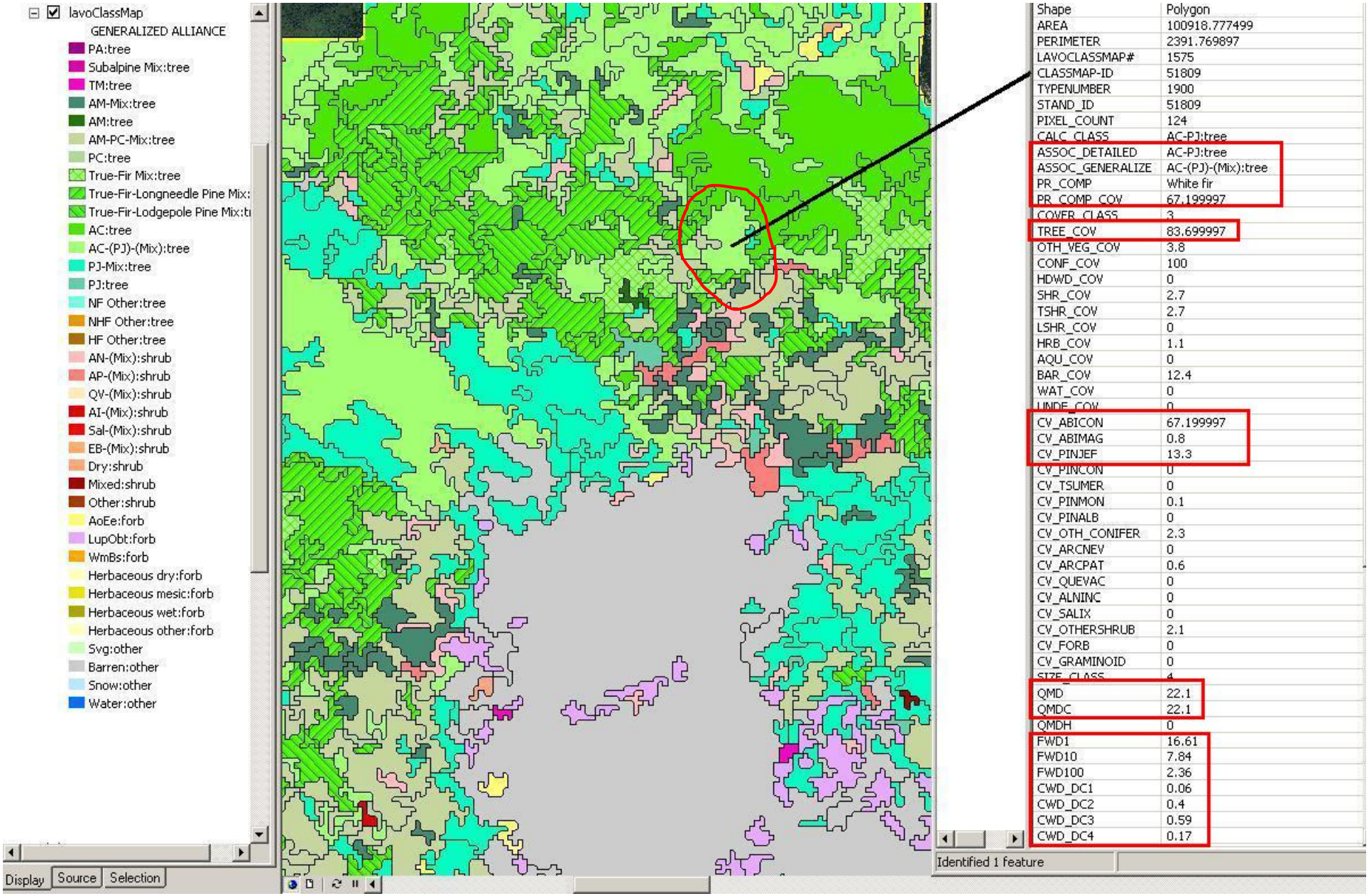
A Second Level of Information(4)

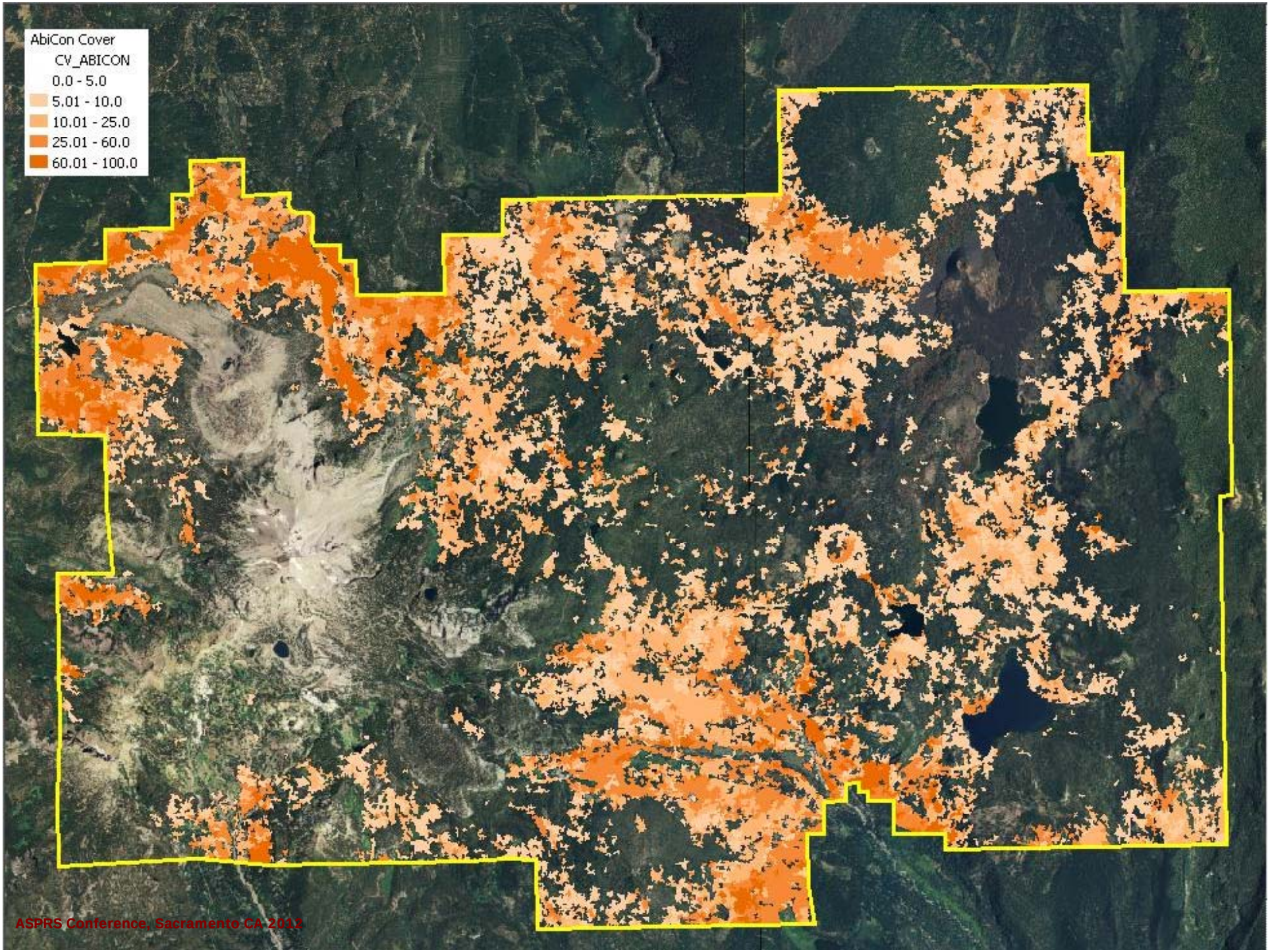
- **Develop Statistics**
  - Variance of the different cover estimates
    - Total values
    - Species-specific values
  - Use variances as an attribute to describe the “clumpiness” of the distribution of the cover
  - Use variances as a statistic to describe confidence limits that can be used to
    - Assign alternate “type” names when estimates are statistically close to a Key threshold
    - Perform Accuracy Assessments based on statistics

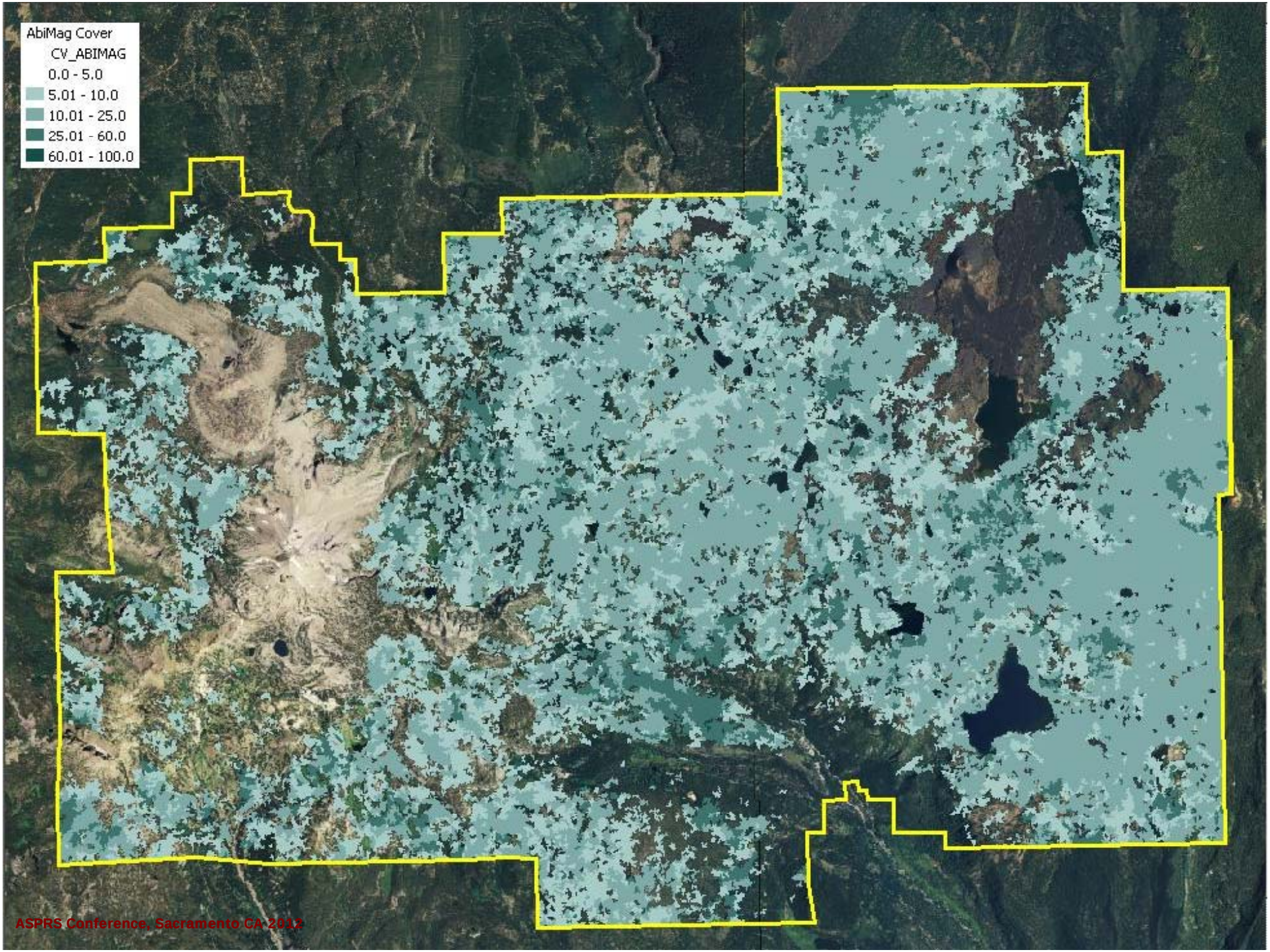
Lassen Volcanic NP DCMM Map

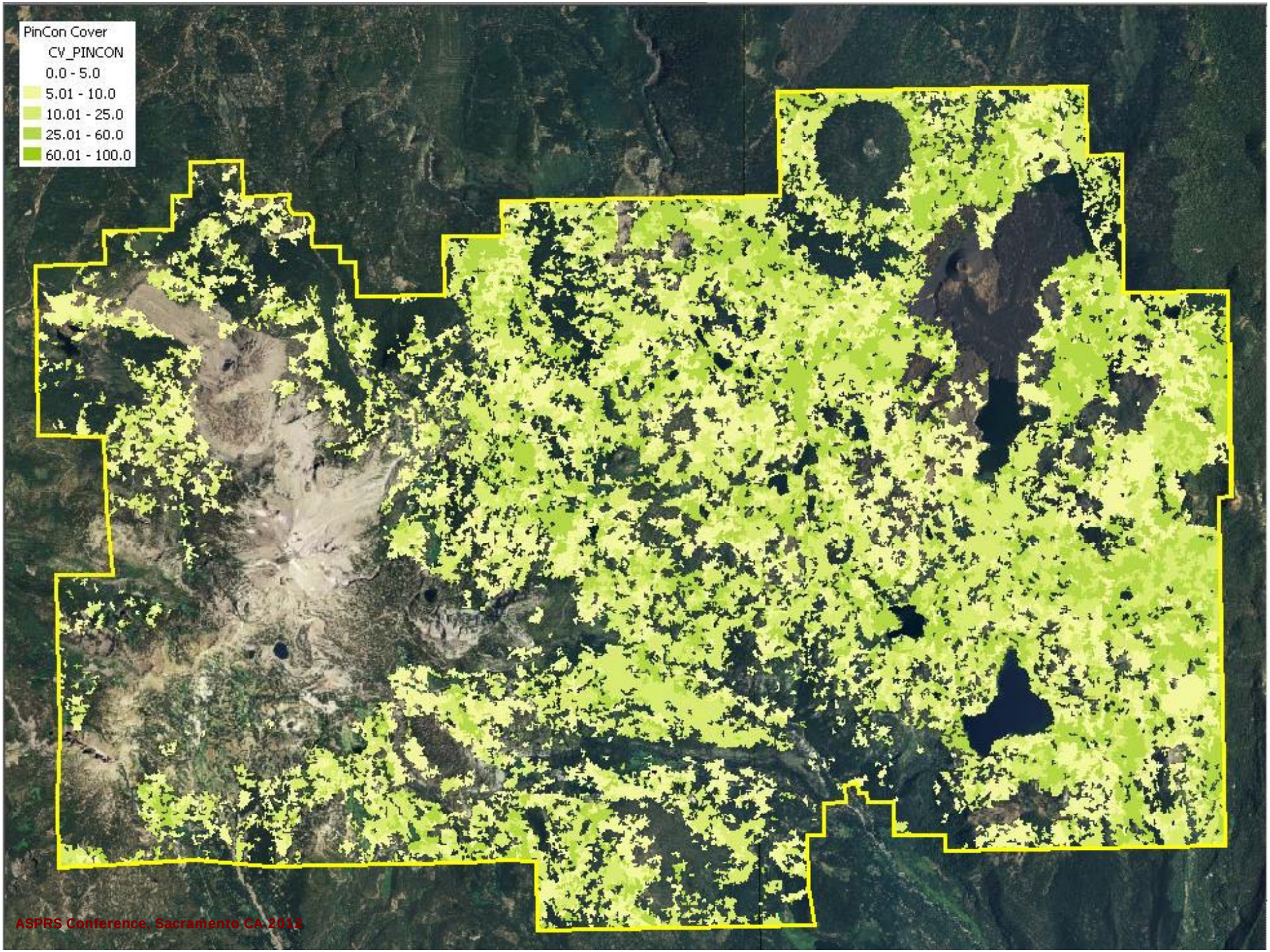


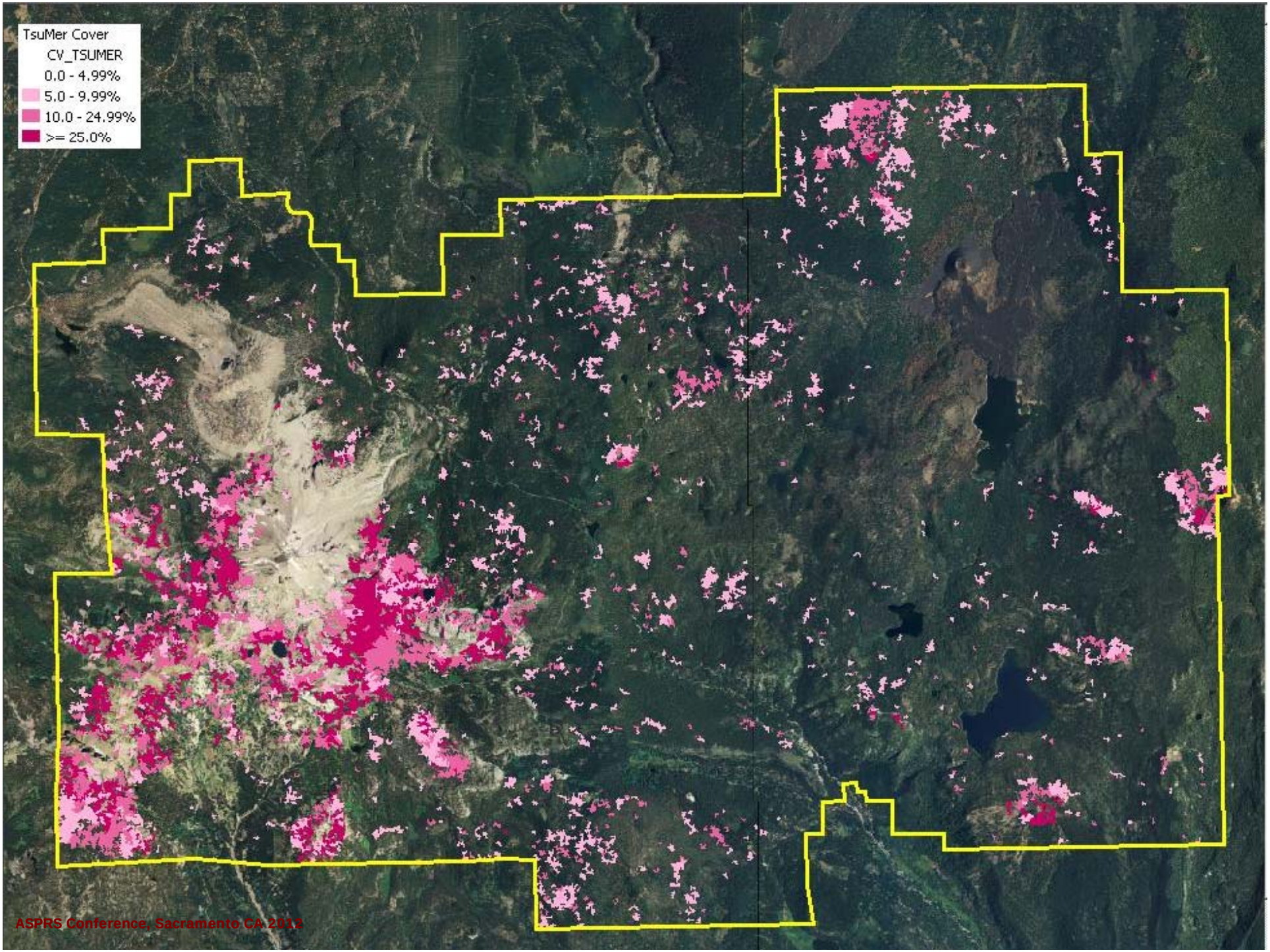
Lassen Volcanic NP DCMM Map




AbiCon Cover
CV_ABICON
0.0 - 5.0
5.01 - 10.0
10.01 - 25.0
25.01 - 60.0
60.01 - 100.0
ASPRS Conference, Sacramento CA 2012


AbiMag Cover
CV_ABIMAG
0.0 - 5.0
5.01 - 10.0
10.01 - 25.0
25.01 - 60.0
60.01 - 100.0
ASPRS Conference, Sacramento CA 2012


PinCon Cover
CV_PINCON
0.0 - 5.0
5.01 - 10.0
10.01 - 25.0
25.01 - 60.0
60.01 - 100.0
ASPRS Conference, Sacramento CA 2012


TsuMer Cover
CV_TSUMER
0.0 - 4.99%
5.0 - 9.99%
10.0 - 24.99%
>= 25.0%
ASPRS Conference, Sacramento CA 2012

A Third Level of Information

- **Each transect point is an individual unique observation of the species and landscape features observed in the different canopy layers at that point location**
- **Lassen Volcanic National Park**
  - 47,228 unique feature observations at 23,174 point locations
- **Redwood National and State Parks**
  - 54,647 unique feature observations at 15,378 point locations

A Third Level of Information

- **Species-specific relationships**
  - Estimate frequency of any species at a point occupied by the "subject" species or landscape feature
  - Evaluate relative to environmental differences or conditions
    - Aspect, elevation, and/or slope
    - Moisture regime
    - Woody debris
    - Eroded versus stable lands
  - Evaluate species relationships and dependencies
    - Redwood associations with *vaccinium ovatum* versus *polysticum munitum* understories

Redwood Point Frequency Distribution

Subject species: ***Sequoia sempervirens***

species_code	species_alpha	freq	%freq
1	**SEQSEM**	**3764**	**100.0%**
817	POLMUN	1157	30.7%
186	VACOVA	935	24.8%
42	LITDEN	690	18.3%
2	PSEMEN	631	16.8%
635	OXAORE	463	12.3%
41	ALNRUB	460	12.2%
153	RHOMAC	327	8.7%
3	TSUHET	271	7.2%
135	GAUSHA	171	4.5%
804	BLESPI	115	3.1%
4	PICSIT	94	2.5%
187	VACPAR	57	1.5%
152	RHAPUR	48	1.3%
779	VIOSEM	45	1.2%
5	ABIGRA	39	1.0%
117	BERNER	34	0.9%
22	PSEMEN(dead)	33	0.9%
514	GALTRI	27	0.7%
849	MOSS	25	0.7%
752	TRIOVA	24	0.6%
21	SEQSEM(dead)	23	0.6%
172	RUBSPE	23	0.6%
746	TRILAT	21	0.6%
371	ASACAU	19	0.5%
438	CLASIB	19	0.5%
820	PTEAQU	19	0.5%
49	UMBCAL	15	0.4%
405	CARCAL	12	0.3%

Point Frequencies – Alder, Tanoak, and Madrone

Subject species: *Alnus rubra*

species_code	species_alpha	freq	%freq
41	ALNRUB	1340	100.0%
817	POLMUN	559	41.7%
1	SEQSEM	460	34.3%
172	RUBSPE	143	10.7%
4	PICSIT	121	9.0%
42	LITDEN	115	8.6%
2	PSEMEN	100	7.5%
186	VACOVA	86	6.4%
670	RANREP	73	5.4%
635	OXAORE	70	5.2%
3	TSUHET	69	5.1%
173	RUBURS	63	4.7%
153	RHOMAC	50	3.7%
135	GAUSHA	45	3.4%
117	BERNER	30	2.2%
339	OTHGRM	29	2.2%
180	SAMRAC	24	1.8%
438	CLASIB	24	1.8%
731	TOLMEN	21	1.6%
803	ATHFIL	21	1.6%
152	RHAPUR	18	1.3%
306	CAROBN	17	1.3%
230	CORJUB	16	1.2%
804	BLESPI	13	1.0%
158	RIBBRA	12	0.9%
171	RUBPAR	12	0.9%
371	ASACAU	12	0.9%
44	ACEMAC	11	0.8%
721	STAAJU	11	0.8%

Subject species: *Lithocarpus densiflorus*

species_code	species_alpha	freq	%freq
42	LITDEN	3302	100.0%
2	PSEMEN	988	29.9%
186	VACOVA	977	29.6%
1	SEQSEM	690	20.9%
153	RHOMAC	535	16.2%
817	POLMUN	374	11.3%
135	GAUSHA	212	6.4%
3	TSUHET	178	5.4%
41	ALNRUB	115	3.5%
635	OXAORE	85	2.6%
50	ARBMEN	69	2.1%
49	UMBCAL	42	1.3%
22	PSEMEN(dead)	37	1.1%
5	ABIGRA	34	1.0%
117	BERNER	33	1.0%
849	MOSS	32	1.0%
151	RHACAL	29	0.9%
11	PINATT	26	0.8%
187	VACPAR	26	0.8%
804	BLESPI	25	0.8%
746	TRILAT	24	0.7%
820	PTEAQU	24	0.7%
780	WHIMOD	23	0.7%
15	PINRXA	20	0.6%
154	RHOOCC	18	0.5%
779	VIOSEM	16	0.5%
62	LITDEN(dead)	15	0.5%
183	TOXDIV	15	0.5%
752	TRIOVA	13	0.4%
125	CORCOR	12	0.4%
781	XERTEN	12	0.4%
405	CARCAL	11	0.3%
438	CLASIB	11	0.3%

Subject species: *Arbutus menziesii*

species_code	species_alpha	freq	%freq
50	ARBMEN	111	100.0%
42	LITDEN	69	62.2%
186	VACOVA	24	21.6%
2	PSEMEN	23	20.7%
153	RHOMAC	7	6.3%
135	GAUSHA	6	5.4%

Point Frequencies – Woody Debris

Subject feature(s): Coarse and fine woody debris

Lassen Volcanic National Park(LAVO)

species_code	species_alpha	freq	%freq
661	**CWD**	**593**	**100.0%**
31	ABICON	103	17.4%
32	ABIMAG	58	9.8%
15	PINCON	44	7.4%
12	PINJEF	19	3.2%
151	CEAVEL	8	1.3%
41	ABICON(dead)	7	1.2%
160	ARCNEV	7	1.2%
22	PINJEF(dead)	6	1.0%
25	PINCON(dead)	6	1.0%
168	QUEVAC	6	1.0%
66	SALLUC	5	0.8%
119	ALNINC	5	0.8%

species_code	species_alpha	freq	%freq
660	**FWD**	**2438**	**100.0%**
31	ABICON	855	35.1%
32	ABIMAG	353	14.5%
15	PINCON	162	6.6%
160	ARCNEV	100	4.1%
12	PINJEF	97	4.0%
41	ABICON(dead)	67	2.7%
151	CEAVEL	45	1.8%
202	ACHOCC	35	1.4%
16	PINMON	30	1.2%
66	SALLUC	30	1.2%
194	CHRSEM	27	1.1%
42	ABIMAG(dead)	25	1.0%
49	TSUMER	25	1.0%
161	ARCPAT	25	1.0%
168	QUEVAC	22	0.9%
201	ELYELY	20	0.8%
22	PINJEF(dead)	19	0.8%
119	ALNINC	18	0.7%
25	PINCON(dead)	16	0.7%
51	CALDEC	16	0.7%
149	CEACOR	12	0.5%
230	GRA_SP	12	0.5%
13	PINLAM	10	0.4%
276	CAR SP	8	0.3%
483	MONODO	8	0.3%
175	ERIBLO	7	0.3%
469	LUPOBT	7	0.3%
495	PENGRA	7	0.3%
466	LUPANG	6	0.2%
166	PURTRI	5	0.2%

Point Frequencies – North and South Aspects

Alliance: *Sequoia sempervirens* (old growth) Forest Alliance

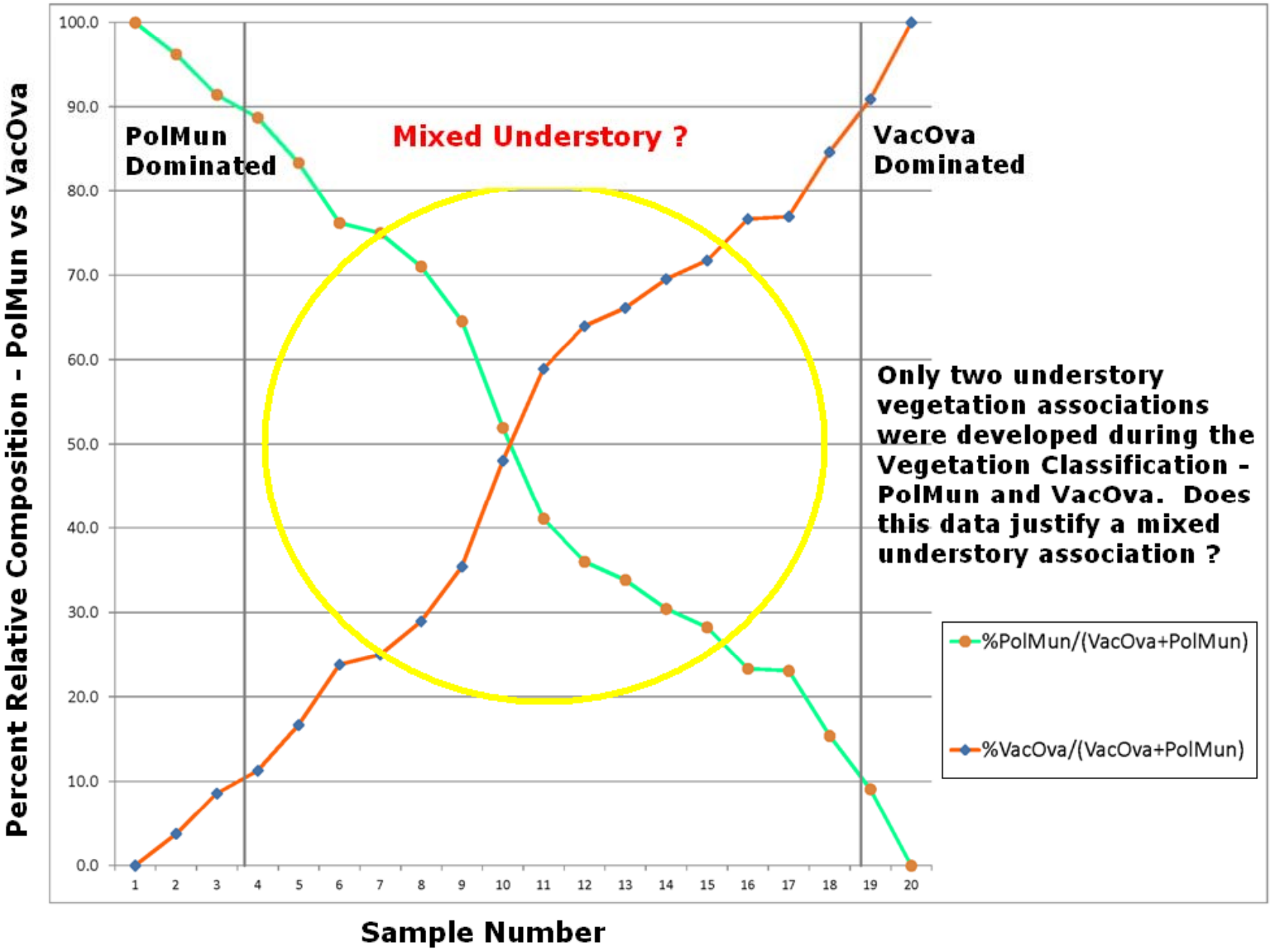
Subject feature(s):Southerly Aspects
Subject species: *Sequoia sempervirens*

species_code	species_alpha	freq	%freq
1	**SEQSEM**	**1867**	**100.0%**
817	POLMUN	574	30.7%
186	VACOVA	543	29.1%
42	LITDEN	348	18.6%
2	PSEMEN	300	16.1%
635	OXAORE	230	12.3%
41	ALNRUB	217	11.6%
153	RHOMAC	157	8.4%
3	TSUHET	90	4.8%
135	GAUSHA	83	4.4%
804	BLESPI	71	3.8%
4	PICSIT	56	3.0%
187	VACPAR	30	1.6%
152	RHAPUR	23	1.2%
5	ABIGRA	22	1.2%
117	BERNER	17	0.9%
779	VIOSEM	17	0.9%
22	PSEMEN(dead)	16	0.9%
21	SEQSEM(dead)	14	0.7%
752	TRIOVA	13	0.7%
371	ASACAU	12	0.6%
746	TRILAT	11	0.6%
172	RUBSPE	8	0.4%
438	CLASIB	8	0.4%
514	GALTRI	6	0.3%
820	PTEAQU	6	0.3%
49	UMBCAL	5	0.3%
112	BACPIL	5	0.3%
849	MOSS	5	0.3%

Northerly Aspects

species_code	species_alpha	freq	%freq
1	**SEQSEM**	**1897**	**100.0%**
817	POLMUN	583	30.7%
186	VACOVA	392	20.7%
42	LITDEN	342	18.0%
2	PSEMEN	331	17.4%
41	ALNRUB	243	12.8%
635	OXAORE	233	12.3%
3	TSUHET	181	9.5%
153	RHOMAC	170	9.0%
135	GAUSHA	88	4.6%
804	BLESPI	44	2.3%
4	PICSIT	38	2.0%
779	VIOSEM	28	1.5%
187	VACPAR	27	1.4%
152	RHAPUR	25	1.3%
514	GALTRI	21	1.1%
849	MOSS	20	1.1%
5	ABIGRA	17	0.9%
22	PSEMEN(dead)	17	0.9%
117	BERNER	17	0.9%
172	RUBSPE	15	0.8%
820	PTEAQU	13	0.7%
438	CLASIB	11	0.6%
752	TRIOVA	11	0.6%
49	UMBCAL	10	0.5%
405	CARCAL	10	0.5%
746	TRILAT	10	0.5%
21	SEQSEM(dead)	9	0.5%
371	ASACAU	7	0.4%
43	ACECIR	6	0.3%
125	CORCOR	6	0.3%
780	WHIMOD	6	0.3%
44	ACEMAC	5	0.3%
721	STAAJU	5	0.3%

Two Redwood Old Growth Associations



Vaccinium ovatum and *Polystichum munitum*

Alliance: *Sequoia sempervirens* (old growth) Forest Alliance
Observation: 1 point

Subject Species: ***Vaccinium ovatum***

species_code	species_alpha	freq	%freq
186	**VACOVA**	**1215**	**100.0%**
1	SEQSEM	586	48.2%
42	LITDEN	350	28.8%
2	PSEMEN	313	25.8%
817	**POLMUN**	**268**	**22.1%**
153	RHOMAC	229	18.8%
3	TSUHET	217	17.9%
635	OXAORE	116	9.5%
135	GAUSHA	73	6.0%
804	BLESPI	49	4.0%
187	VACPAR	28	2.3%
4	PICSIT	12	1.0%
152	RHAPUR	11	0.9%
752	TRIOVA	11	0.9%

Polystichum munitum

species_code	species_alpha	freq	%freq
817	**POLMUN**	**1224**	**100.0%**
1	SEQSEM	769	62.8%
635	OXAORE	379	31.0%
186	**VACOVA**	**268**	**21.9%**
3	TSUHET	205	16.7%
42	LITDEN	188	15.4%
2	PSEMEN	144	11.8%
804	BLESPI	109	8.9%
153	RHOMAC	104	8.5%
135	GAUSHA	47	3.8%
187	VACPAR	41	3.3%
152	RHAPUR	23	1.9%
41	ALNRUB	19	1.6%
125	CORCOR	19	1.6%
4	PICSIT	16	1.3%
172	RUBSPE	13	1.1%
371	ASACAU	11	0.9%
752	TRIOVA	11	0.9%
779	VIOSEM	11	0.9%

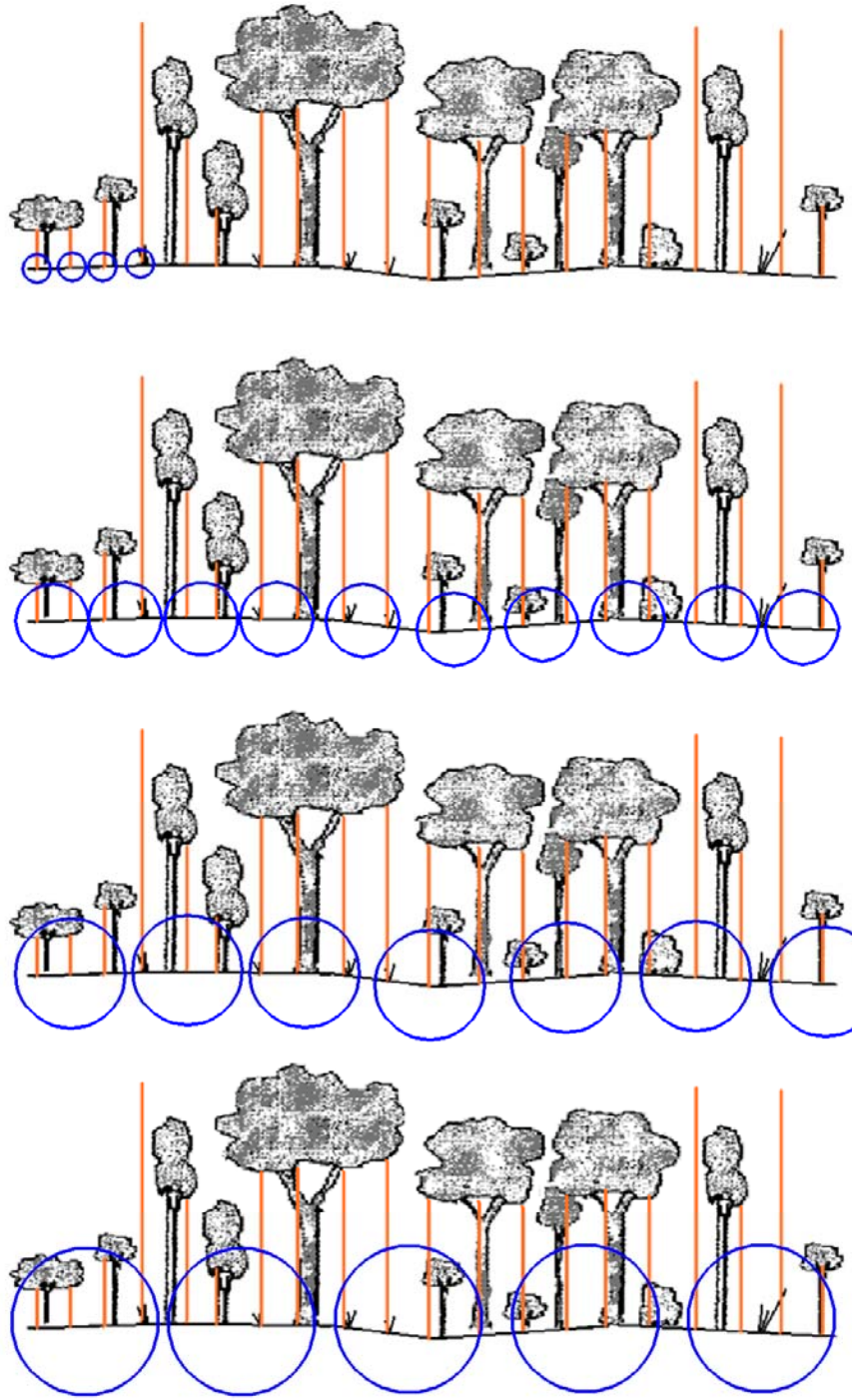
Treat consecutive points as “one” observation

Point interval = 15 feet

2 points = ± 15 feet

3 points = ± 30 feet

4 points = ± 45 feet



Vaccinium ovatum and *Polystichum munitum*

Alliance: *Sequoia sempervirens* (old growth) Forest Alliance
Observation: 2 consecutive points

Subject Species: *Vaccinium ovatum*

species_code	species_alpha	freq	%freq
186	**VACOVA**	**826**	**100.0%**
1	SEQSEM	514	62.2%
817	**POLMUN**	**351**	**42.5%**
42	LITDEN	313	37.9%
2	PSEMEN	265	32.1%
153	RHOMAC	241	29.2%
3	TSUHET	182	22.0%
635	OXAORE	164	19.9%
135	GAUSHA	98	11.9%
804	BLESPI	72	8.7%
187	VACPAR	49	5.9%
152	RHAPUR	17	2.1%
752	TRIOVA	15	1.8%
4	PICSIT	13	1.6%
779	VIOSEM	13	1.6%

Polystichum munitum

species_code	species_alpha	freq	%freq
817	**POLMUN**	**851**	**100.0%**
1	SEQSEM	618	72.6%
635	OXAORE	364	42.8%
186	**VACOVA**	**351**	**41.2%**
3	TSUHET	213	25.0%
42	LITDEN	189	22.2%
2	PSEMEN	150	17.6%
804	BLESPI	133	15.6%
153	RHOMAC	123	14.5%
135	GAUSHA	75	8.8%
187	VACPAR	56	6.6%
152	RHAPUR	30	3.5%
779	VIOSEM	20	2.4%
752	TRIOVA	19	2.2%
4	PICSIT	17	2.0%
125	CORCOR	17	2.0%
41	ALNRUB	14	1.6%
746	TRILAT	13	1.5%
371	ASACAU	12	1.4%
514	GALTRI	11	1.3%

Vaccinium ovatum and *Polystichum munitum*

Alliance: *Sequoia sempervirens* (old growth) Forest Alliance
Observation: 3 consecutive points

Subject Species: *Vaccinium ovatum*

species_code	species_alpha	freq	%freq
186	**VACOVA**	**633**	**100.0%**
1	SEQSEM	450	71.1%
817	**POLMUN**	**333**	**52.6%**
42	LITDEN	283	44.7%
2	PSEMEN	236	37.3%
153	RHOMAC	227	35.9%
3	TSUHET	170	26.9%
635	OXAORE	162	25.6%
135	GAUSHA	101	16.0%
804	BLESPI	76	12.0%
187	VACPAR	54	8.5%
752	TRIOVA	19	3.0%
152	RHAPUR	18	2.8%
779	VIOSEM	15	2.4%
4	PICSIT	12	1.9%
514	GALTRI	11	1.7%

Polystichum munitum

species_code	species_alpha	freq	%freq
817	**POLMUN**	**660**	**100.0%**
1	SEQSEM	528	80.0%
186	**VACOVA**	**333**	**50.5%**
635	OXAORE	317	48.0%
3	TSUHET	200	30.3%
42	LITDEN	181	27.4%
2	PSEMEN	147	22.3%
804	BLESPI	131	19.8%
153	RHOMAC	117	17.7%
135	GAUSHA	75	11.4%
187	VACPAR	63	9.5%
152	RHAPUR	30	4.5%
752	TRIOVA	23	3.5%
779	VIOSEM	23	3.5%
514	GALTRI	18	2.7%
4	PICSIT	17	2.6%
125	CORCOR	17	2.6%
746	TRILAT	15	2.3%
371	ASACAU	12	1.8%
405	CARCAL	11	1.7%
849	MOSS	11	1.7%

Vaccinium ovatum and *Polystichum munitum*

Alliance: *Sequoia sempervirens* (old growth) Forest Alliance
Observation: 4 consecutive points

Subject Species: *Vaccinium ovatum*

species_code	species_alpha	freq	%freq
186	**VACOVA**	**528**	**100.0%**
1	SEQSEM	408	77.3%
817	**POLMUN**	**310**	**58.7%**
42	LITDEN	253	47.9%
2	PSEMEN	222	42.0%
153	RHOMAC	204	38.6%
635	OXAORE	170	32.2%
3	TSUHET	160	30.3%
135	GAUSHA	106	20.1%
804	BLESPI	78	14.8%
187	VACPAR	56	10.6%
752	TRIOVA	23	4.4%
152	RHAPUR	21	4.0%
779	VIOSEM	20	3.8%
4	PICSIT	13	2.5%
117	BERNER	12	2.3%
514	GALTRI	12	2.3%

Polystichum munitum

species_code	species_alpha	freq	%freq
817	**POLMUN**	**535**	**100.0%**
1	SEQSEM	449	83.9%
186	**VACOVA**	**310**	**57.9%**
635	OXAORE	287	53.6%
3	TSUHET	189	35.3%
42	LITDEN	169	31.6%
2	PSEMEN	153	28.6%
804	BLESPI	121	22.6%
153	RHOMAC	112	20.9%
135	GAUSHA	82	15.3%
187	VACPAR	64	12.0%
152	RHAPUR	28	5.2%
779	VIOSEM	24	4.5%
752	TRIOVA	23	4.3%
4	PICSIT	17	3.2%
514	GALTRI	17	3.2%
125	CORCOR	15	2.8%
746	TRILAT	15	2.8%
117	BERNER	12	2.2%
371	ASACAU	12	2.2%
849	MOSS	12	2.2%
41	ALNRUB	11	2.1%
405	CARCAL	11	2.1%

Line-point Transect Methodology

- **Comprehensive**
- **Objective**
- **Accurate**
- **Generates Discrete Estimates and Statistics**
- **Easy to Learn / Train**
  - Employed high school students in Galena Alaska
- **Economical**
  - **$200 / site** for both RNSP and LAVO Field data collection efforts including all direct and indirect overhead.
  - Crews averaged 3 – 4 sites per day

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Accuracy Citations

Alaska Interagency Fire Effects Task Group (FETG). "Fire Effects Monitoring Protocol (Version 1.0)." April 2007: 44pp.

Fiala, Anne C.S., Garman, Steven L., Gray, Andrew N. "Comparison of Five Canopy Cover Estimation Techniques in the Western Oregon Cascades." *Forest Ecology and Management* 232, 2006:188-197.

Huynh, M.L. "Assessment of Various Methods of Canopy Cover Estimation That Yield Accurate Results With Field Repeatability." MSc. Thesis, Northern Airzona University, Flagstaff, AZ., 2005.

Jennings, S.B., Brown, N.D. and Sheil, D. "Assessing Forest Canopies and Understory Illumination: Canopy Closure, Canopy Cover and Other Measures." *Forestry* 72(1), 1999:59-73.

Korhonen, Lauri, Korhonen, Kari T., Rautiainen, Miina and Stenberg, Pauline. "Estimation of Forest Canopy Cover: a Comparison of Field Measurement Techniques." *Silva Fennica* 40(4) 2006: 577-588.

Paletto, Alessandro, Tosi, Vittorio. "Forest Canopy Cover and Canopy Closure: Comparison of Assessment Techniques." *European Journal of Forest Research* 128 2009: 265-272

Robards T.A., Berbach, M. W., Cafferata, P.H. and Valentine, B.E. "A Comparison of Techniques for Measuring Canopy in Watercourse and Lake Protection Zones." *California Forestry Note* No. 115, June 2000:1-15

Line-point Transect Methodology

- **Data provides a solid foundation for:**
  - Ecological field assessment and characterization
  - Vegetation Classification
    - Vegetation Descriptions
  - Quantitative mapping applications
  - Other ecological analyses
  - **Monitoring gradual species-specific change(s)**
  - **Evaluation of species dependencies**
  - **Evaluation of minimum sample size limits**
  - **Evaluation of minimum mapping unit size limits**

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Questions and Comments