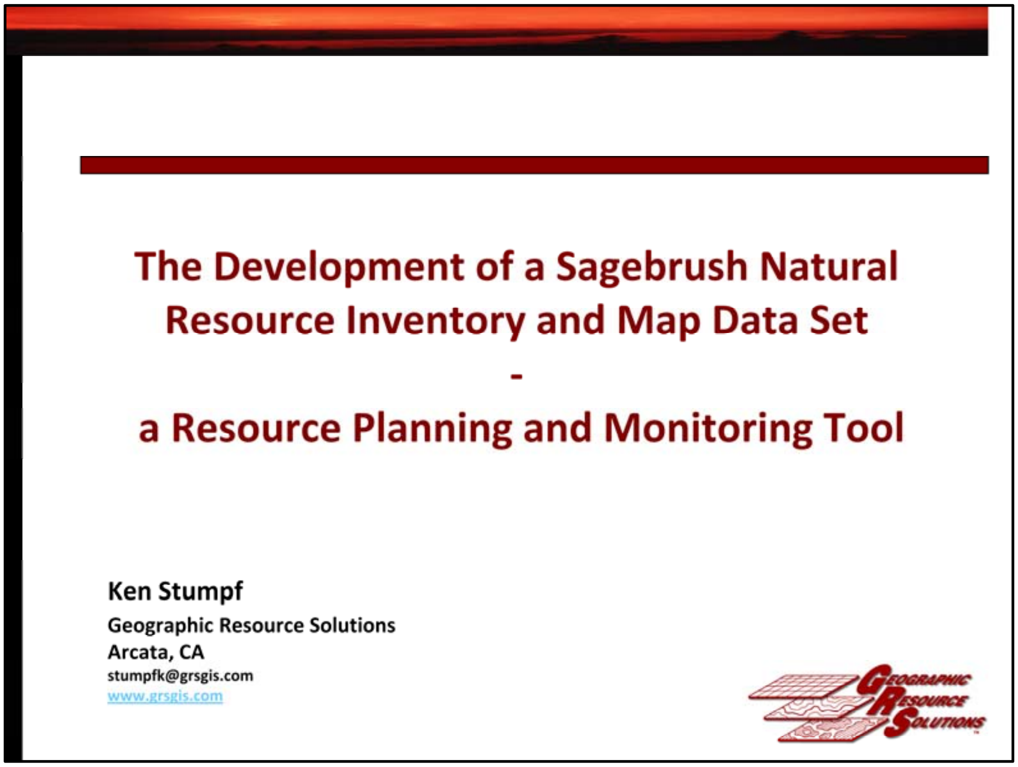


Why am I here ?

in August 2014, I was in Sac for the ESA conference sitting in on the NVCS mapping session hosted by Todd Keeler-Wolf of Cal Fish & Wildlife and Julie Evens of CNPS.

This session was covering the state of NVCS mapping in California. I found it quite interesting.

At the close Dr. Janet Franklin of ASU was talking about the future of Mapping and displayed a diagram relating current mapping abilities to image resolution.

She speculated that modeling individual species cover was 15-20 years in the future.

That really got my attention because we were already mapping, not modeling, individual species cover during our past and present NPS projects.

I had never really talked much about these species-specific mapping efforts in California and the Park Service staff certainly haven't and likely won't as they have their own Mapping & Inventory Program.

And so I started to reach out to people with similar interests to see if they were interested in finding out more about what we had accomplished.

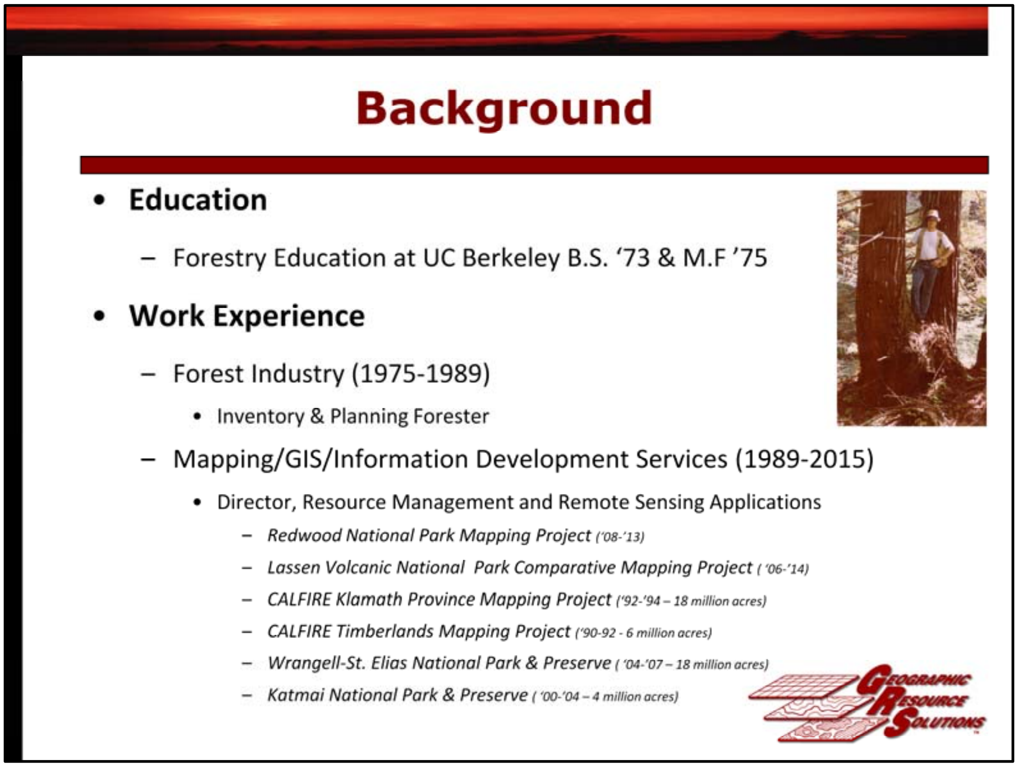
And so here I am.

==================

I love what I do.

I will try to keep this non-technical, but some technical terms are unavoidable.

==================



I received my education at Cal with a very well rounded education in Forestry. At this point in my career looking back, I couldn't be more pleased about my experiences at Cal and the education I received. I had some very noteworthy professors both in and outside of the School of Forestry and Conservation.

I then was quite fortunate to land a job with one of the major forest industries in the redwood region, a company noted for its progressive approach to managing their timberlands. My position was a new one and it encompassed some very interesting responsibilities.

I worked in the field and in the office, performed covertyping using stereo photography, wax pencils, and a zoom transfer scope, and ran the inventory field crews.

I was responsible for training, which primarily involved developing consistency of the data collection efforts by seasonal staff and the elimination of errors.

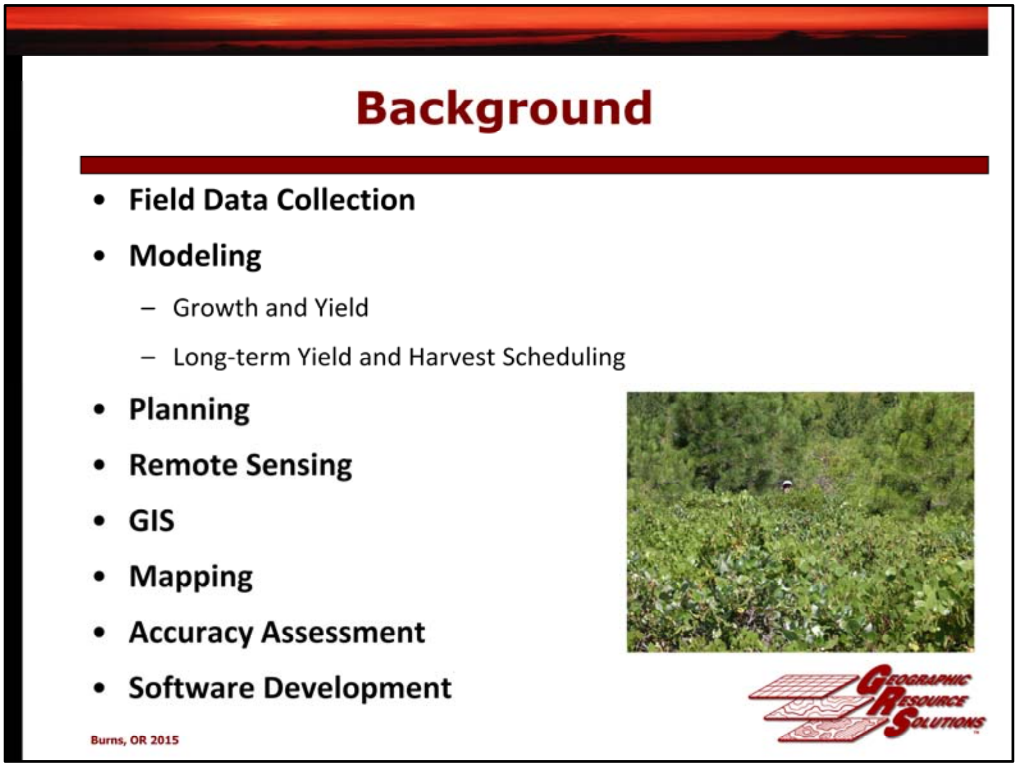
Participated in the **Early Development of GIS capabilities** - justified by integration of data, the value of "good" information, and the prospects of decreasing, if not eliminating, the odds of making poor or bad decisions!

Cost = $280K was based on the value of GOOD INFORMATION !

I am a Cofounder of Geographic Resource Solutions

Started performing Image Classification Services back in the early 1990's when
we landed the Cal Timberlands Mapping (6MM) and Cal Klamath Province (18MM) Projects.
Both were based on the CDFG WHR Classification system, but we quickly found out the generalized methods taught in school didn't work well over large areas

And so I developed a means to map cover and tree size as continuous variables



I have been fortunate to have developed experience in a wide range of natural resource oriented fields

I have also been able to experience first hand some of the problems that currently exist when trying

to use the mapping data sets that have been developed to represent the natural resources we are charged with managing.

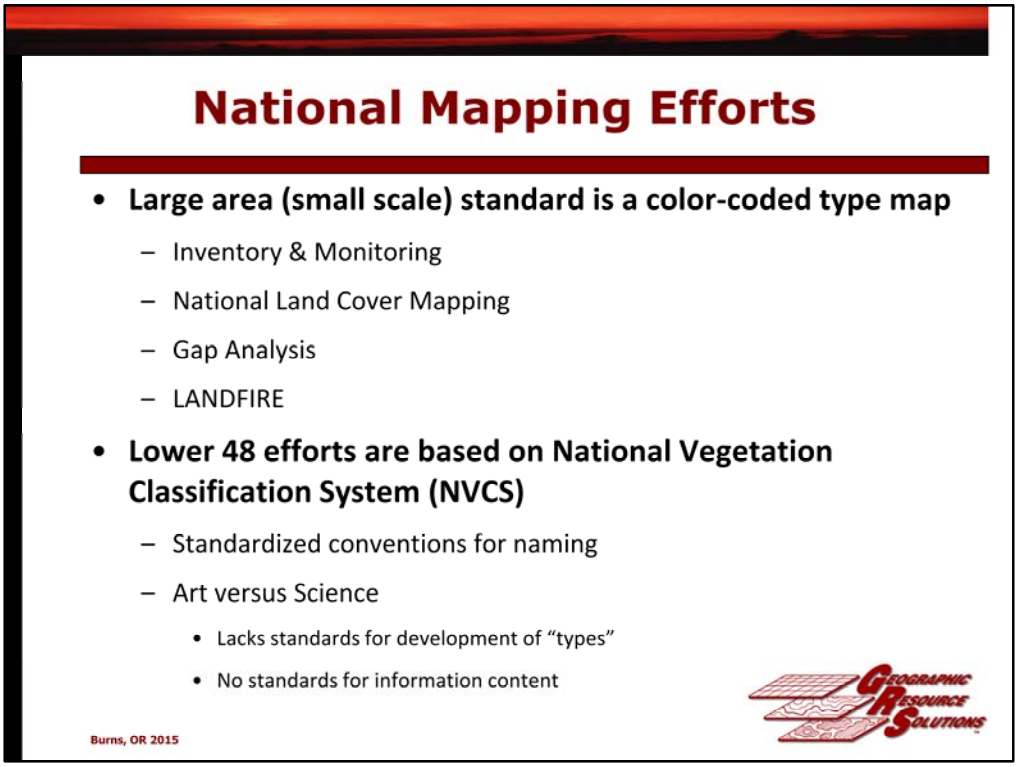
I have never liked the "seat-of-the-pants" model or the "quick-and-dirty" approach.

I have always wanted data that were meaningful and useful.

In summary, I am a planner, mapper, modeler, developer, and (importantly) a USER of the various types of resource information for which I was responsible.

I **quickly learned to appreciate** the **value** of resource information, the **effort** necessary to develop and maintain it,

and **how it could be used** in resource management and planning efforts.



I have performed considerable work for DOI since 1997 mapping nearly 25-million acres

I am sufficiently experienced with the DOI standards to know that the minimum requirement is to produce a type map that may have as many as three cover density classes.

All of these mapping projects in are based on the National Vegetation Classification System (NVCS)

This is simply a naming system developed to **standardize** the naming of different vegetation types.

I have worked on Vegetation Classification efforts, actually analyzing the field sample data to develop Associations and write vegetation descriptions for both the LAVO and RNSP projects.

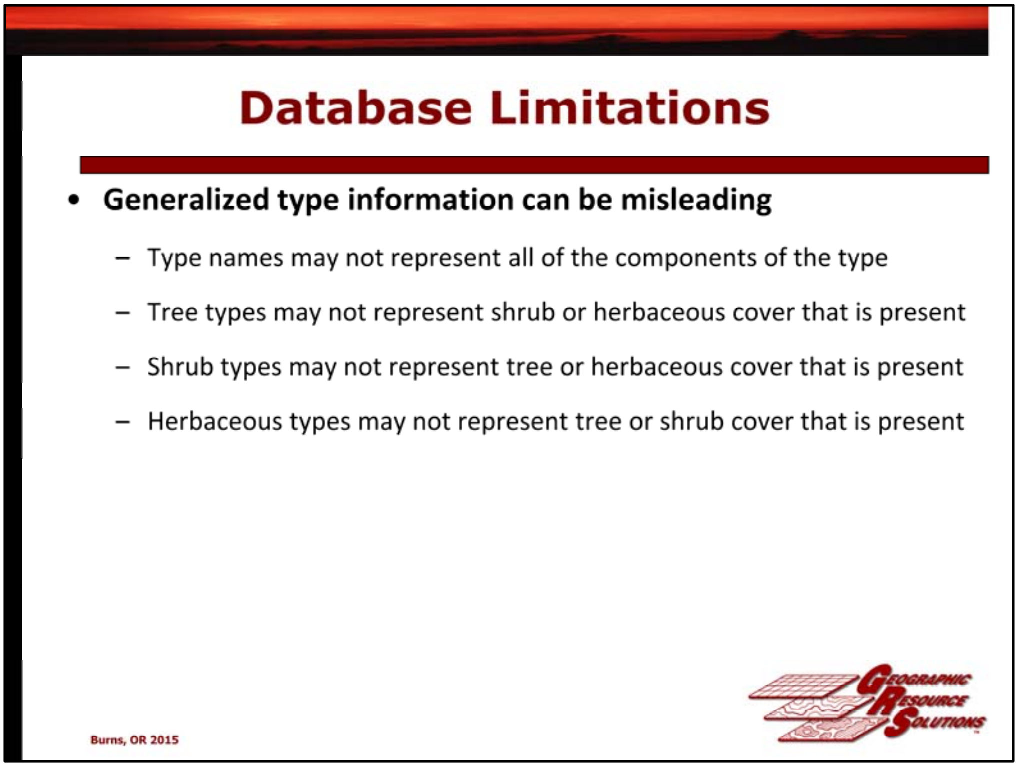
Vegetation Classification is not an absolute science and unfortunately, in my opinion, the NVCS does not enforce standards of how types are classified, but only how they are named.

There are no standards regarding information content.

Vegetation descriptions may contain averages and ranges of species specific information,
but I find maps based on these type names are generalized type maps and are quite limited in their ability to support planning applications.

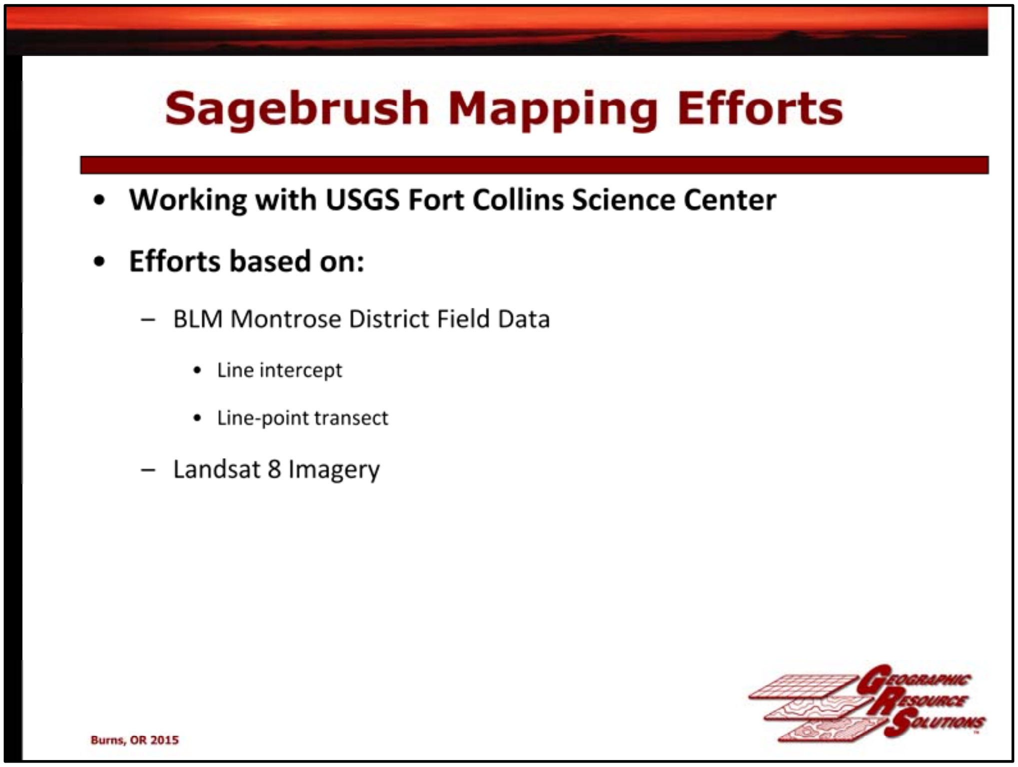
Beach Sea Rocket Alliance = 1 plant with < 0.5% cover on beach sand was a TYPE!!!!!!

No definitions for Barren or Water Types … any plant life tends to qualify the area as a plant type, no matter how little plant cover.

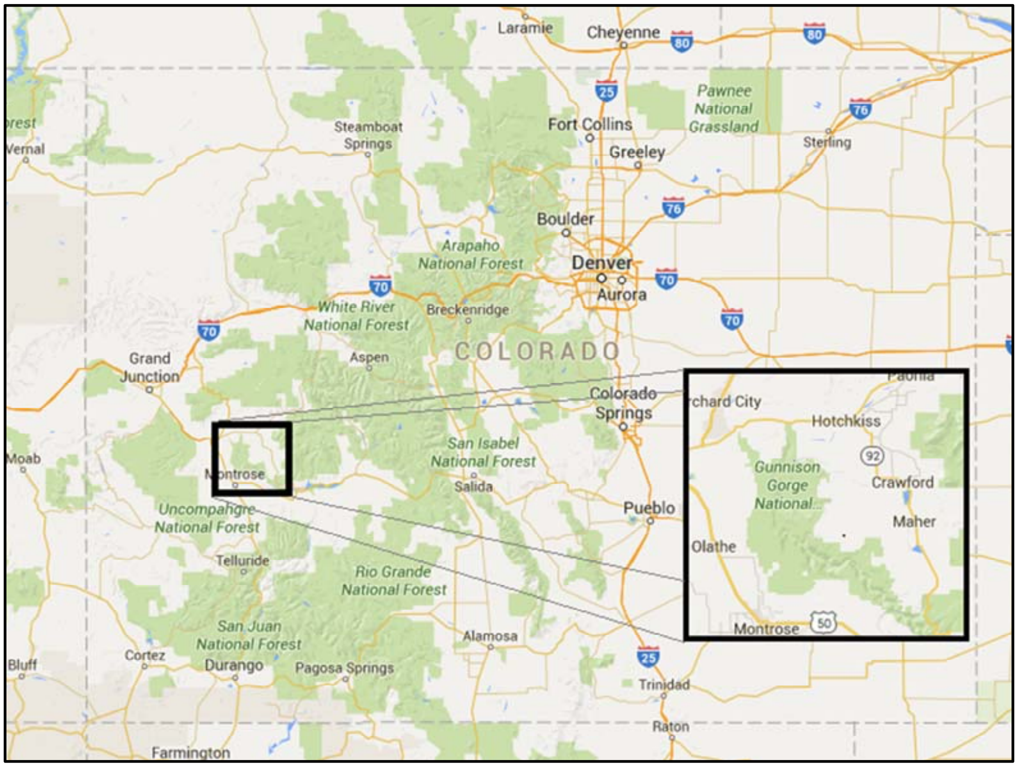


I found that Type level information may be incomplete and misleading …

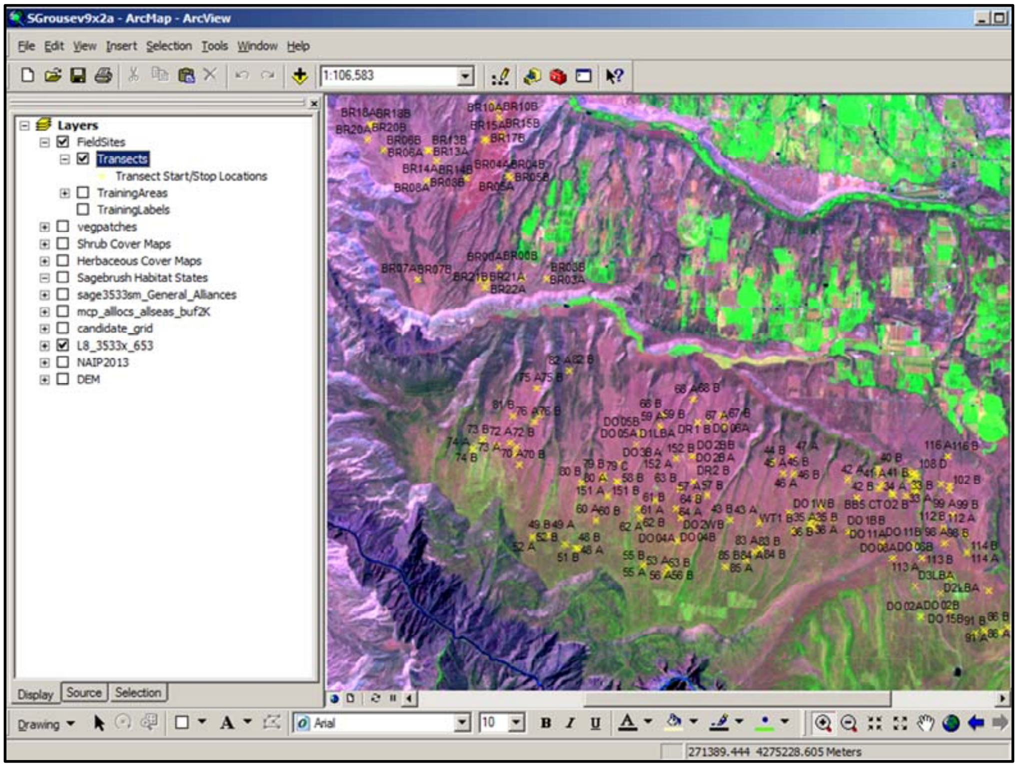
We may see this as we look at some of our recent Sagebrush mapping results in just a few moments …



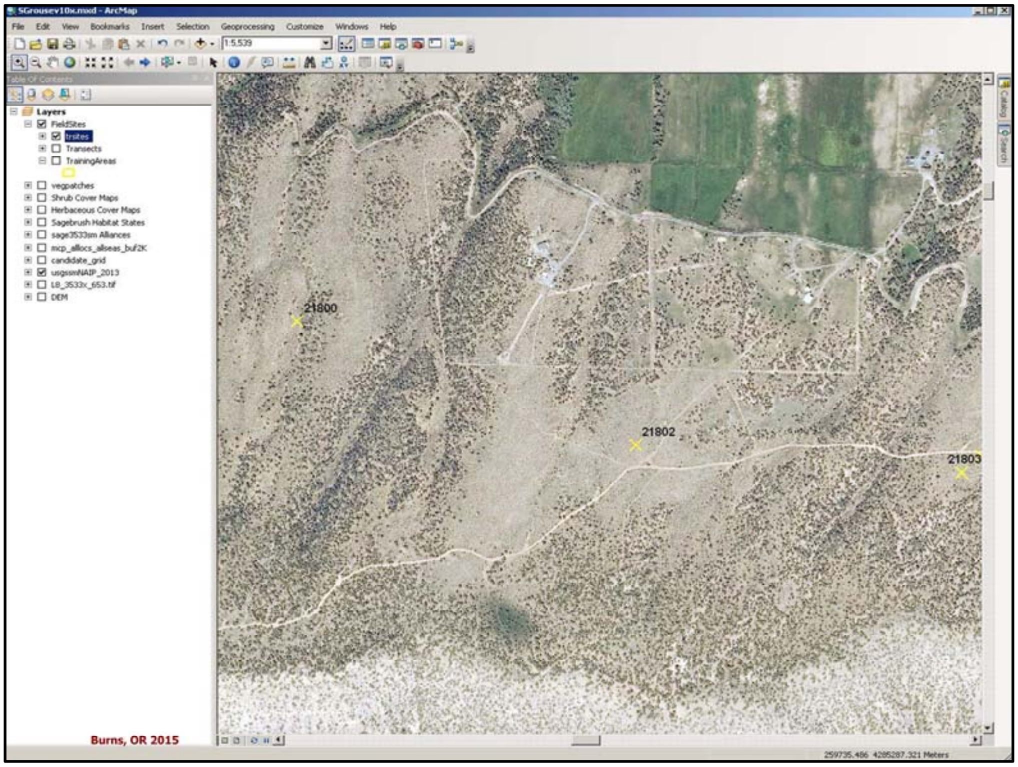
Current efforts are based on BLM field site data (2013-2015) …



The Area of Interest for our current sagebrush mapping effort is located in western Colorado



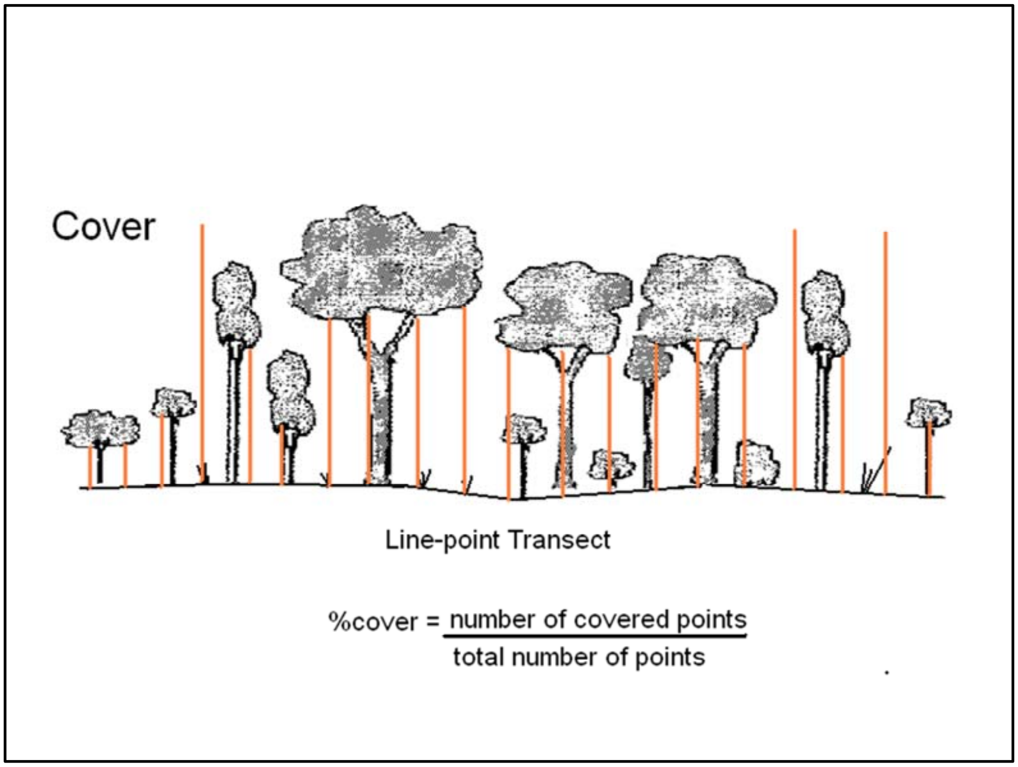
Landsat 8 imagery (bands 6,5, and 3) and Field Site locations



Recent BLM field sampling efforts were based on a stratification based on management practices.

This is a view of 3 field site locations and 2013 NAIP imagery.

Sites were sampled using line-intercept and line-point transects.



The line-point transect methodology is easy to learn/train. In addition, cover computations are easy.

In 2012 we used a BLM Grant to train and hire Native American HS Students during our Galena Biomass Inventory Project

and after 2 days of training they worked right along side our botanists.

No hard decisions with this methodology - the results are accurate, repeatable, and standardized.

Percent Cover Summary for Top Layer:
Site/Polygon Id: 21800
Number of Sites/Pixels: 1

Dbh Size Class: / Species	<= 4.95"	> 4.95" <= 9.95"	> 9.95" <=12.95"	>12.95" <=15.95"	>15.95" <=18.95"	>18.95"	Tree Cover	Non-Tree Cover	Total Cover
Utah Juniper	3.0	0.0	0.0	0.0	0.0	0.0	3.0		3.0
Pinyon Pine	1.0	0.0	0.0	0.0	0.0	0.0	1.0		1.0
Totals	4.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	4.0

Tree Cover Composition Summary for Top Layer 4.0 Cover:

Dbh Size Class: / Species	<= 4.95"	> 4.95" <= 9.95"	> 9.95" <=12.95"	>12.95" <=15.95"	>15.95" <=18.95"	>18.95"	All Sizes
Utah Juniper	75.0	0.0	0.0	0.0	0.0	0.0	75.0
Pinyon Pine	25.0	0.0	0.0	0.0	0.0	0.0	25.0
Totals	100.0	0.0	0.0	0.0	0.0	0.0	100.0

Percent conifer composition= 100.0
Percent hardwood composition= 0.0
Most common specie is Utah Juniper with 75.0 percent cover composition

Percent Cover Summary for Over-Topped Layer:
Site/Polygon Id: 21800
Number of Sites/Pixels: 1

Dbh Size Class: / Species	<= 4.95"	> 4.95" <= 9.95"	> 9.95" <=12.95"	>12.95" <=15.95"	>15.95" <=18.95"	>18.95"	Tree Cover	Non-Tree Cover	Total Cover
Totals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NO TREE COVER/Quad Mean DBH TO REPORT

Percent Cover Summary for Pole/Sapling/Shrub Layer:
Site/Polygon Id: 21800
Number of Sites/Pixels: 1

Dbh Size Class: / Species	<= 4.95"	> 4.95" <= 9.95"	> 9.95" <=12.95"	>12.95" <=15.95"	>15.95" <=18.95"	>18.95"	Tree Cover	Non-Tree Cover	Total Cover
Mt. Big Sage								6.0	6.0
Wy. Big Sage								7.0	7.0
Totals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	13.0

NO TREE COVER/Quad Mean DBH TO REPORT

Let’s look at some of the data available from the BLM field sites.

Species Cover Totals and Composition represent the first level of field site detail/information

Values by canopy layer represent a second level of information …

Percent Cover Summary for Ground Layer:
Site/Polygon Id: 21800
Number of Sites/Pixels: 1

Dbh Size Class: Species	<= 4.95"	> 4.95" <= 9.95"	> 9.95" <=12.95"	>12.95" <=15.95"	>15.95" <=18.95"	>18.95"	Tree Cover	Non-Tree Cover	Total Cover
Broom Snkeweed								1.0	1.0
pricklypear								1.5	1.5
Indian Ricegrs								2.0	2.0
Crested Whtgrs								1.0	1.0
Muttongrass								1.0	1.0
Sandbrg Blugrs								3.0	3.0
Cheatgrass								20.0	20.0
Arrowlf Blsmrt								1.0	1.0
Madwort								3.0	3.0
Unknown mustar								0.5	0.5
Totals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.0	34.0

NO TREE COVER/Quad Mean DBH TO REPORT

Percent Cover Summary for Surface Condition Layer:
Site/Polygon Id: 21800
Number of Sites/Pixels: 1

Dbh Size Class: Species	<= 4.95"	> 4.95" <= 9.95"	> 9.95" <=12.95"	>12.95" <=15.95"	>15.95" <=18.95"	>18.95"	Tree Cover	Non-Tree Cover	Total Cover
NonVascular/Mo								7.0	7.0
Rock								10.0	10.0
Soil								41.0	41.0
Litter								42.0	42.0
Totals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0

NO TREE COVER/Quad Mean DBH TO REPORT

Ground layer and Ground conditions

Percent Cover Summary for Bird's-eye Layer:
Site/Polygon Id: 21800
Number of Sites/Pixels: 1

Dbh Size Class: / Species	<= 4.95"	> 4.95" <= 9.95"	> 9.95" <=12.95"	>12.95" <=15.95"	>15.95" <=18.95"	>18.95"	Tree Cover	Non-Tree Cover	Total Cover
Utah Juniper	3.0	0.0	0.0	0.0	0.0	0.0	3.0		3.0
Pinyon Pine	1.0	0.0	0.0	0.0	0.0	0.0	1.0		1.0
Broom Snkeweed								1.0	1.0
pricklypear								0.5	0.5
Mt. Big Sage								6.0	6.0
Wy. Big Sage								7.0	7.0
Indian Ricegrs								1.0	1.0
Crested Whtgrs								1.0	1.0
Muttongrass								1.0	1.0
Sandbrg Blugrs								3.0	3.0
Cheatgrass								16.0	16.0
Arrowlf Blsmrt								1.0	1.0
Madwort								3.0	3.0
Unknown mustar								0.5	0.5
NonVascular/Mo								4.0	4.0
Rock								10.0	10.0
Soil								30.0	30.0
Litter								11.0	11.0
Totals	4.0	0.0	0.0	0.0	0.0	0.0	4.0	96.0	100.0

Tree Cover Composition Summary for Bird's-eye Layer 4.0 Cover:

Dbh Size Class: / Species	<= 4.95"	> 4.95" <= 9.95"	> 9.95" <=12.95"	>12.95" <=15.95"	>15.95" <=18.95"	>18.95"	All Sizes
Utah Juniper	75.0	0.0	0.0	0.0	0.0	0.0	75.0
Pinyon Pine	25.0	0.0	0.0	0.0	0.0	0.0	25.0
Totals	100.0	0.0	0.0	0.0	0.0	0.0	100.0

Percent conifer composition= 100.0
Percent hardwood composition= 0.0
Most common specie is Utah Juniper with 75.0 percent cover composition

Bird's-eye view cover values as seen from above – overtopped characteristics are not included.

Percent Cover Summary for All Layers:
Site/Polygon Id: 21800
Number of Sites/Pixels: 1

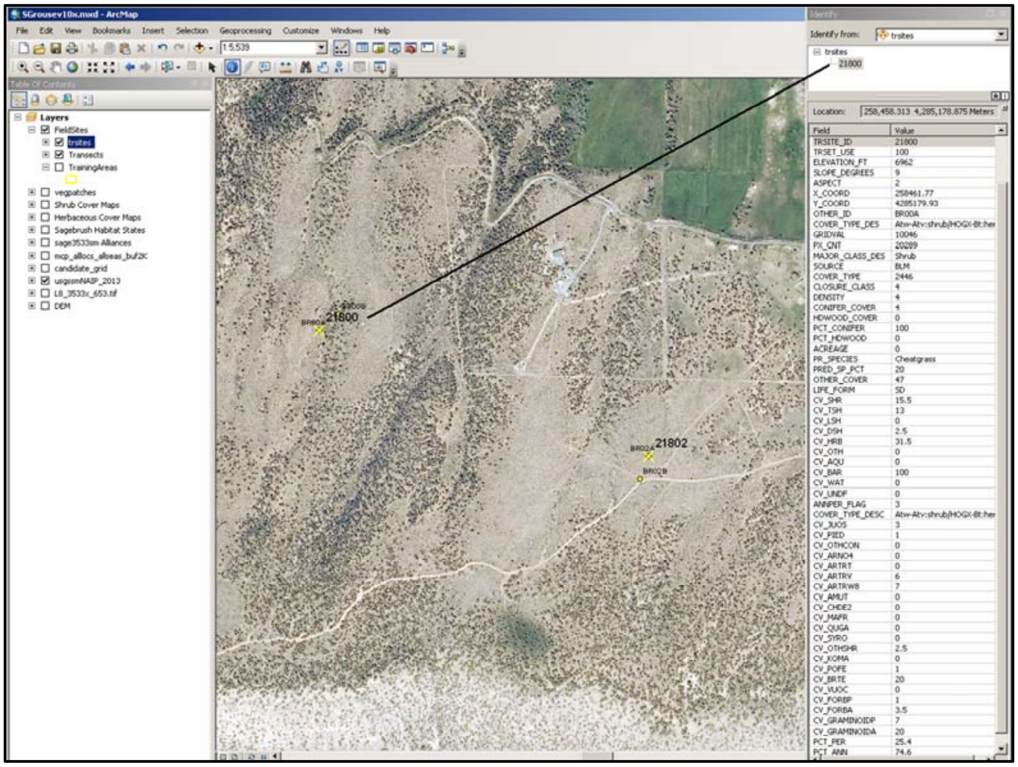
Dbh Size Class: Species	<= 4.95"	> 4.95" <= 9.95"	> 9.95" <=12.95"	>12.95" <=15.95"	>15.95" <=18.95"	>18.95"	Tree Cover	Non-Tree Cover	Total Cover
Utah Juniper	3.0	0.0	0.0	0.0	0.0	0.0	3.0		3.0
Pinyon Pine	1.0	0.0	0.0	0.0	0.0	0.0	1.0		1.0
Broom Snkeweed								1.0	1.0
pricklypear								1.5	1.5
Mt. Big Sage								6.0	6.0
Wy. Big Sage								7.0	7.0
Indian Ricegrs								2.0	2.0
Crested Whtgrs								1.0	1.0
Muttongrass								1.0	1.0
Sandbrg Blugrs								3.0	3.0
Cheatgrass								20.0	20.0
Arrowlf Blsmrt								1.0	1.0
Madwort								3.0	3.0
Unknown mustar								0.5	0.5
NonVascular/Mo								7.0	7.0
Rock								10.0	10.0
Soil								41.0	41.0
Litter								42.0	42.0
Totals	4.0	0.0	0.0	0.0	0.0	0.0	4.0	147.0	151.0

Tree Cover Composition Summary for All Layers 4.0 Cover:

Dbh Size Class: Species	<= 4.95"	> 4.95" <= 9.95"	> 9.95" <=12.95"	>12.95" <=15.95"	>15.95" <=18.95"	>18.95"	All Sizes
Utah Juniper	75.0	0.0	0.0	0.0	0.0	0.0	75.0
Pinyon Pine	25.0	0.0	0.0	0.0	0.0	0.0	25.0
Totals	100.0	0.0	0.0	0.0	0.0	0.0	100.0

Percent conifer composition= 100.0
Percent hardwood composition= 0.0
Most common specie is Utah Juniper with 75.0 percent cover composition

Total (all layers) characteristics …



We can process the field data ... To develop different types of info about a field site,

such as type names and conditions …. All of this info can be loaded into a GIS map layer and is accessible for processing

Type 4400: *Arctostaphylos patula* Shrubland

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
Pinus Jeffreyi	25	0.3	1	1	50	0.1	0.5	0.5
Abies concolor	25	1.2	5	5	25	0.4	1.7	1.7
Cercocarpus ledifolius	25	0.3	1	1	25	0.1	0.5	0.5
Pinus contorta var. murrayana	T	T	T	T	25	T	T	T
Abies magnifica	T	T	T	T	25	T	T	T
Total tree		**1.8**				**0.6**		
Arctostaphylos patula	100	91	85	98	100	92.7	88.3	98
Ceanothus velutinus	25	0.8	3	3	50	1.2	1.5	3.3
Chrysolepis sempervirens	25	1.3	5	5	25	0.4	1.7	1.7
Total shrub		**93.1**				**94.3**		
Kelloggia galioides	25	0.3	1	1	25	0.3	1	1
Total herbaceous		**0.3**				**0.3**		
Total nonvascular		**0**				**0**		
Barren - litter	75	3	2	6	100	50	4	100
Barren - fine gravelly soil	25	1.3	5	5	25	1.3	5	5
Barren - rock	25	0.3	1	1	25	0.3	1	1
Barren - bare soil	25	0.3	1	1	25	0.3	1	1
Total other		**4.9**				**51.9**		
Totals		**100.1**				**147.1**		

It is this type of information that supports analyses like vegetation classification

Tertiary level … ARNO4

Point Frequency data are based on individual point observations
2-Point Frequency data are based on treating 2 consecutive points as an individual point observation
3-Point Frequency data are based on treating 3 consecutive points as an individual point observation
and so forth ...

Different frequency distributions can be generated for any species, type, or environmental (site) factor such as slope, aspect, elevations, and so forth.

Shrubs

ARNO4 Point Frequency Data

species_code	species	count	% freq
132	ARNO4	551	100.000000
641	EL	343	62.250453
645	S	122	22.141560
213	KOMA	88	15.970961
219	POFE	59	10.707803
646	L	53	9.618874
221	POSE	36	6.533575
385	COPA3	22	3.992740
203	AGCR	12	2.177858
363	PHLO2	12	2.177858

(10 row(s) affected)

ARNO4 2-Point Frequency Data

species_code	species	count	% freq
132	ARNO4	553	100.000000
641	EL	486	87.884267
645	S	365	66.003616
213	KOMA	149	26.943942
219	POFE	96	17.359855
646	L	87	15.732368
221	POSE	71	12.839059
644	R	37	6.690777
385	COPA3	30	5.424954
203	AGCR	21	3.797468
363	PHLO2	19	3.435804
362	PEPU7	17	3.074141
659	BAR	16	2.893309
101	CHDE2	14	2.531645
643	M	14	2.531645
209	ELEL5	13	2.350813

(16 row(s) affected)

ARNO4 3-Point Frequency Data

species_code	species	count	% freq
641	ARNO4	553	100.000000
645	EL	553	100.000000
132	S	553	100.000000
213	KOMA	205	37.070524
646	L	126	22.784810
219	POFE	116	20.976491
221	POSE	95	17.179023
644	R	65	11.754068
385	COPA3	40	7.233273
203	AGCR	36	6.509945
362	PEPU7	29	5.244122
101	CHDE2	26	4.701627
363	PHLO2	23	4.159132
209	ELEL5	20	3.616636
643	M	18	3.254972
131	AMUT	15	2.712477
642	DUFF	15	2.712477
659	BAR	15	2.712477
134	ARTRV	12	2.169981

(19 row(s) affected)

Burns, OR 2015

Recently I discovered a third level of information … similar in concept to veg classification but at the point observation levels.

Point observations … for Black Sage

Tertiary level … ARTRV

ARTRV Point Frequency Data

species_code	species	count	% freq
134	ARTRV	775	100.000000
641	EL	508	65.548387
645	S	110	14.193548
646	L	94	12.129032
213	KOMA	90	11.612903
219	POFE	66	8.516129
220	POPR	61	7.870967
385	COPA3	52	6.709677
203	AGCR	51	6.580645
221	POSE	42	5.419354
643	M	33	4.258064
363	PHLO2	20	2.580645
209	ELEL5	17	2.193548
242	BRTE	17	2.193548
223	THIN6	11	1.419354
350	LUCA	11	1.419354

(16 row(s) affected)

ARTRV 2-Point Frequency Data

species_code	species	count	% freq
134	ARTRV	775	100.000000
641	EL	730	94.193548
645	S	360	46.451612
646	L	142	18.322580
213	KOMA	139	17.935483
219	POFE	91	11.741935
220	POPR	84	10.838709
385	COPA3	81	10.451612
203	AGCR	68	8.774193
221	POSE	66	8.516129
643	M	52	6.709677
131	AMUT	34	4.387096
242	BRTE	29	3.741935
363	PHLO2	28	3.612903
209	ELEL5	26	3.354838
214	PASM	24	3.096774
223	THIN6	23	2.967741
350	LUCA	18	2.322580
142	QUGA	16	2.064516
644	R	15	1.935483
207	CAGE2	13	1.677419
212	HECOC8	12	1.548387
362	PEPU7	12	1.548387

(23 row(s) affected)

ARTRV 3-Point Frequency Data

species_code	species	count	% freq
134	ARTRV	775	100.000000
641	EL	775	100.000000
645	S	604	77.935483
646	L	194	25.032258
213	KOMA	182	23.483870
219	POFE	121	15.612903
385	COPA3	99	12.774193
203	AGCR	93	12.000000
220	POPR	93	12.000000
221	POSE	93	12.000000
643	M	58	7.483870
131	AMUT	49	6.322580
242	BRTE	47	6.064516
363	PHLO2	43	5.548387
214	PASM	39	5.032258
142	QUGA	35	4.516129
209	ELEL5	32	4.129032
350	LUCA	26	3.354838
223	THIN6	25	3.225806
644	R	24	3.096774
362	PEPU7	21	2.709677
212	HECOC8	16	2.064516
310	ASTRA	16	2.064516
143	SYRO	14	1.806451
207	CAGE2	14	1.806451
101	CHDE2	12	1.548387
132	ARNO4	12	1.548387
135	ARTRW8	11	1.419354
399	PEDIC	11	1.419354

(29 row(s) affected)

Burns, OR 2015

Point observations … for Mountain Big Sage

Tertiary level … BRTE

BrTe Point Frequency Data

species_code	species	count	% freq
242	BRTE	805	100.000000
646	L	448	55.652173
645	S	252	31.304347
641	EL	90	11.180124
381	ALAL3	26	3.229813
131	AMUT	21	2.608695
134	ARTRV	17	2.111801
203	AGCR	17	2.111801
219	POFE	14	1.739130
135	ARTRW8	13	1.614906
354	MESA	13	1.614906
210	ELTRT	12	1.490683

(12 row(s) affected)

BrTe 2-Point Interval Frequency Data

species_code	species	count	% freq
242	BRTE	805	100.000000
646	L	578	71.801242
645	S	374	46.459627
641	EL	135	16.770186
131	AMUT	35	4.347826
203	AGCR	35	4.347826
381	ALAL3	34	4.223602
219	POFE	33	4.099378
134	ARTRV	29	3.602484
135	ARTRW8	28	3.478260
210	ELTRT	23	2.857142
354	MESA	20	2.484472
142	QUGA	12	1.490683
209	ELEL5	12	1.490683
221	POSE	12	1.490683
642	DUFF	12	1.490683
643	M	11	1.366459

(17 row(s) affected)

BrTe 3-Point Interval Frequency Data

species_code	species	count	% freq
242	BRTE	805	100.000000
646	L	672	83.478260
645	S	464	57.639751
641	EL	169	20.993788
219	POFE	55	6.832298
131	AMUT	46	5.714285
203	AGCR	45	5.590062
381	ALAL3	43	5.341614
134	ARTRV	40	4.968944
135	ARTRW8	40	4.968944
210	ELTRT	24	2.981366
221	POSE	22	2.732919
354	MESA	21	2.608695
209	ELEL5	17	2.111801
220	POPR	17	2.111801
642	DUFF	17	2.111801
143	SYRO	15	1.863354
212	HECOC8	14	1.739130
213	KOMA	13	1.614906
142	QUGA	12	1.490683
385	COPA3	11	1.366459
392	LAOCO	11	1.366459
643	M	11	1.366459

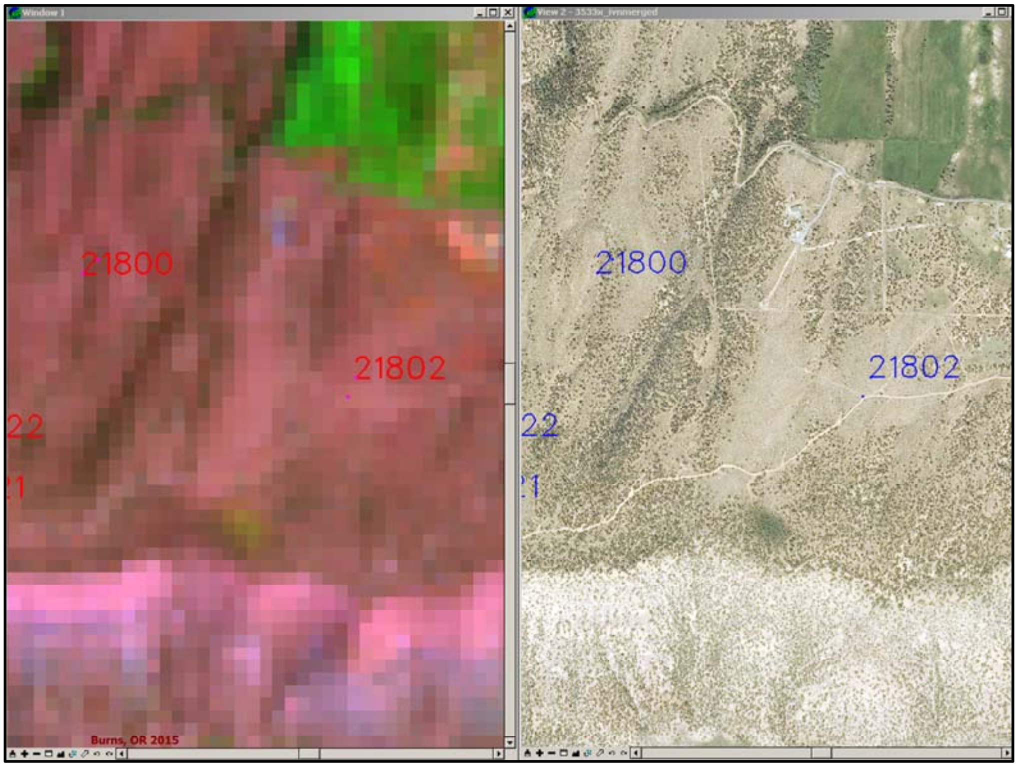
(23 row(s) affected)

Geographic Resource Solutions

Burns, OR 2015

Point observations … for Cheatgrass

Many frequency distributions can be generated at many levels of spacing … based on many different site characteristics and/or species.



We use all of these detailed field data with the Landsat imagery to develop our resource information that we will eventually store in our

Resource inventory map data set.

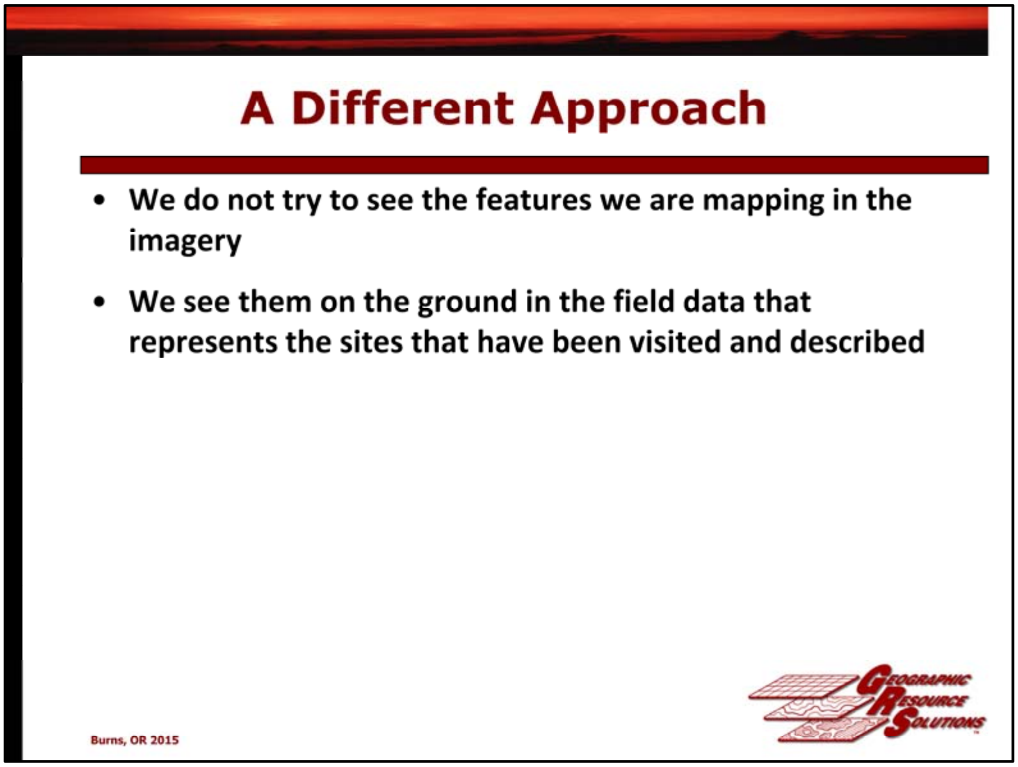
Is there Skepticism about our use of Landsat imagery ?

Why skepticism ?

You cannot see these features in the imagery !

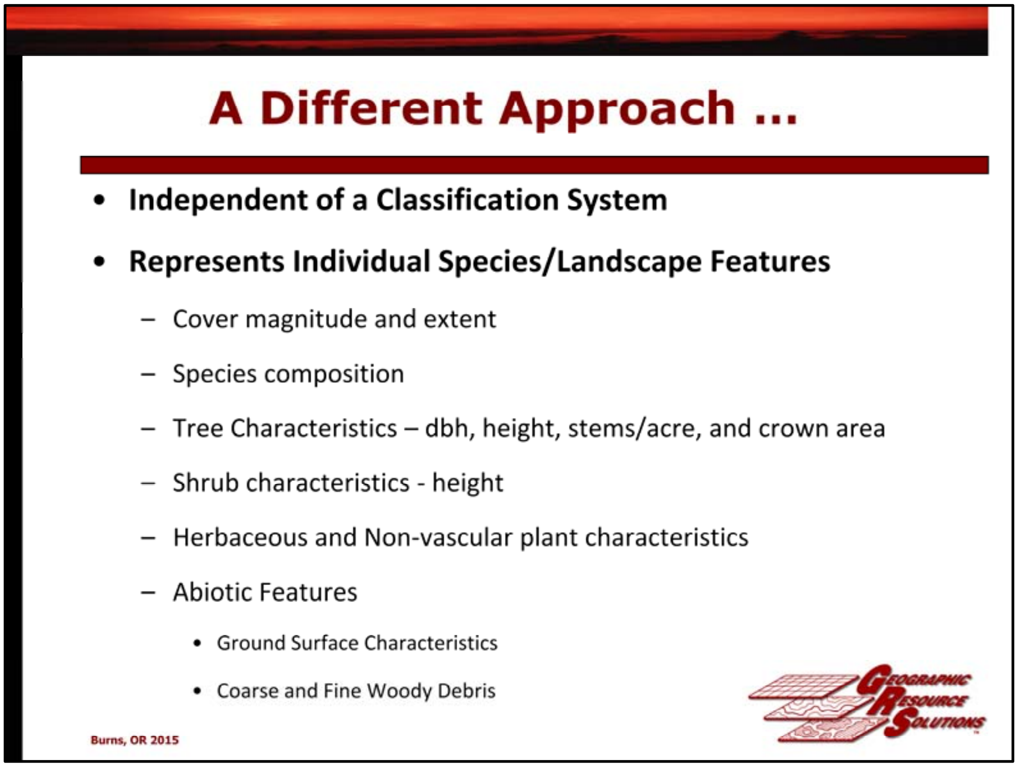
That’s right, but we don’t see them in the imagery.

We do not using methods taught at our colleges ... But rather a different approach



Our approach is different !

We see these features on the ground in the field data set(s)



We relate these field data to distinct spectral signatures we can discriminate in the imagery.

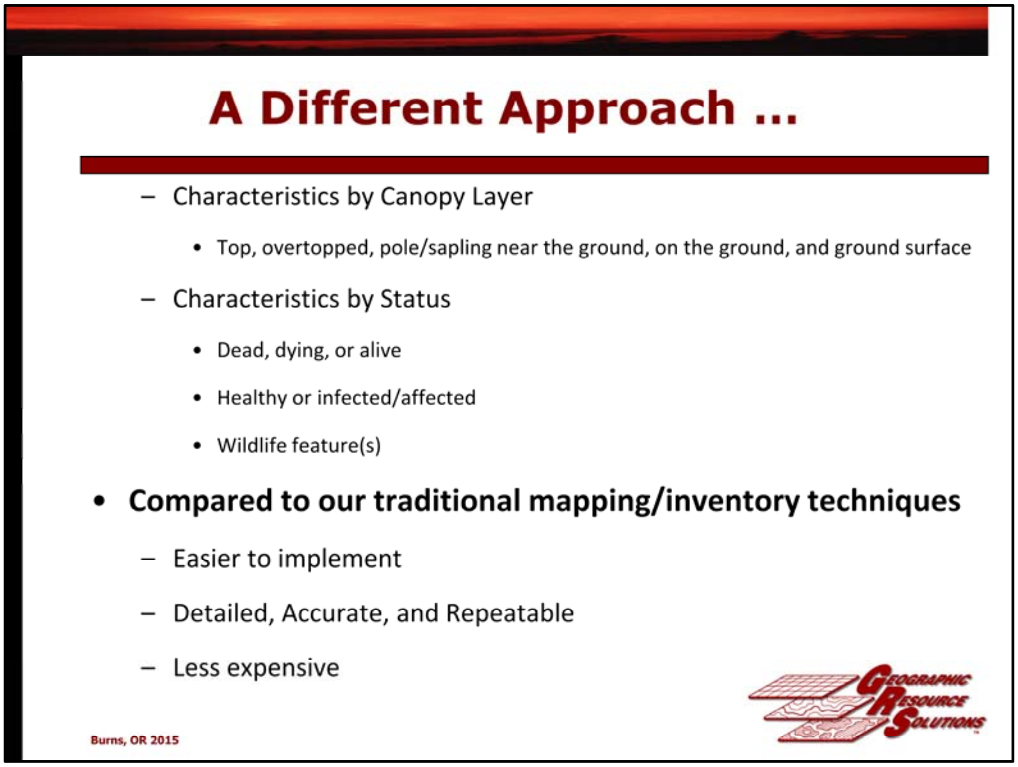
We use a comprehensive approach designed to collect detailed accurate field data that will provide a solid foundation for our inventory and mapping efforts. We integrate all of the field data into our resulting map data set.

Our approach is …

Classification independent

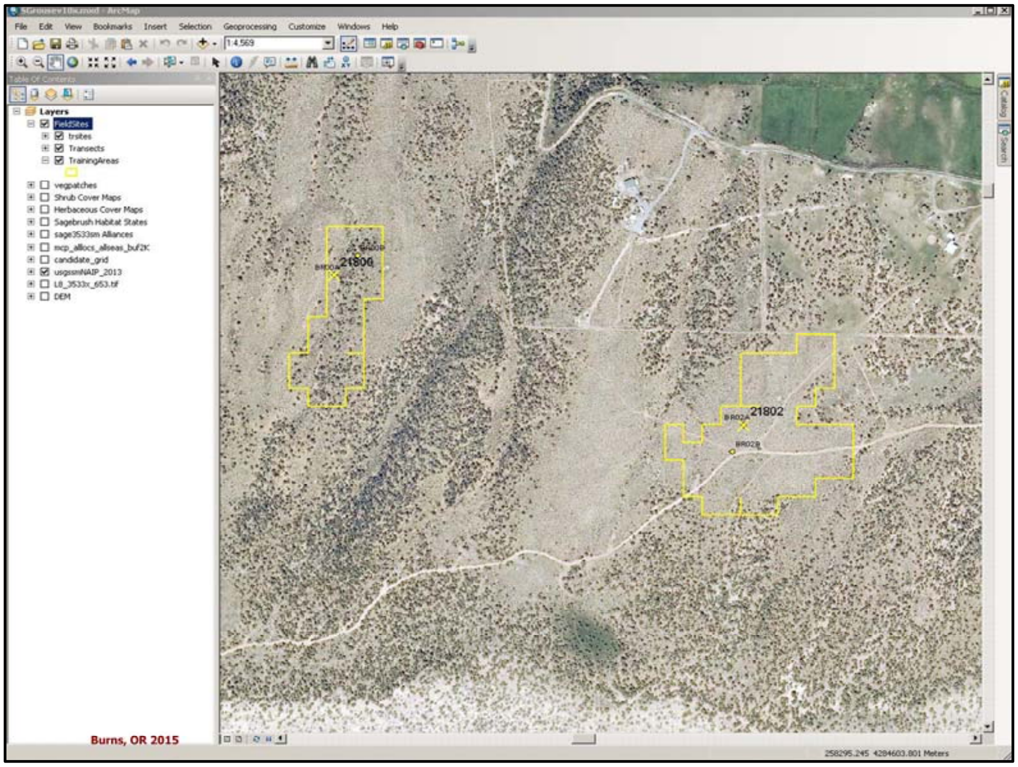
Species/Landscape-feature specific

…



Our field data collection approach is easy to implement **consistently and accurately** by staff of different levels of expertise –

It enables seasonal staff to collect data comparable to that collected by experienced staff.



Our image classification approach is relatively easy to implement …

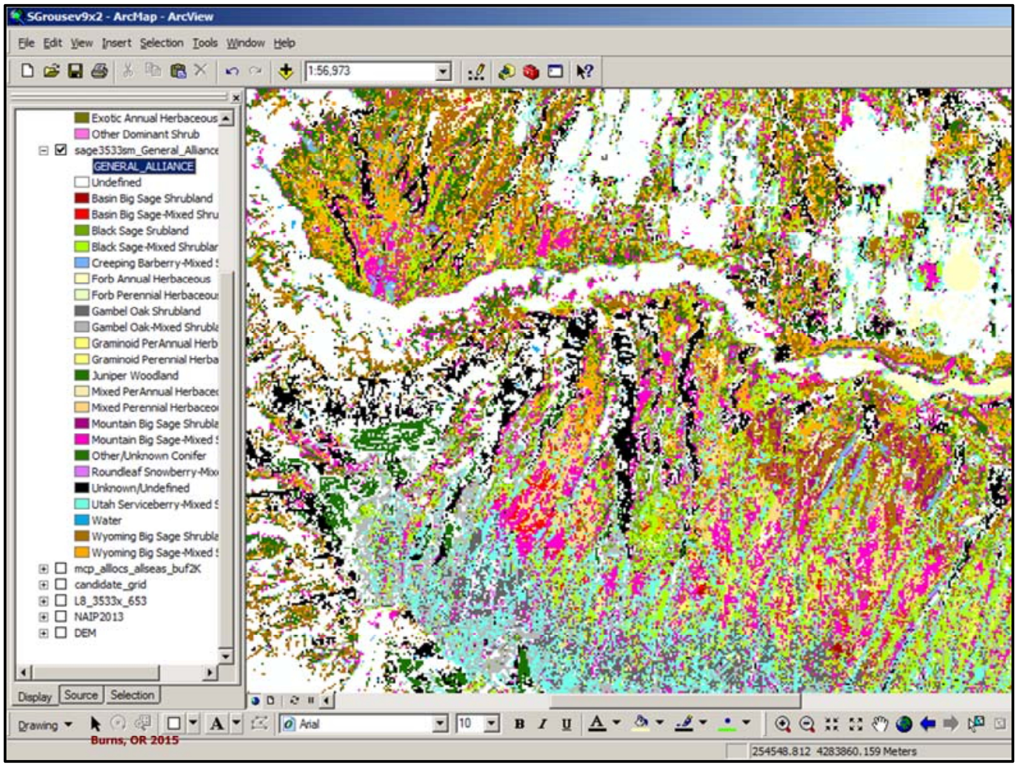
In a nutshell … we relate each field site to an individual statistically valid spectral signature and map many, many shades of gray

that represent the different plant communities found in our project area.

After performing all of our quality control processes … and correcting any spectral confusion we can develop our output classification maps.

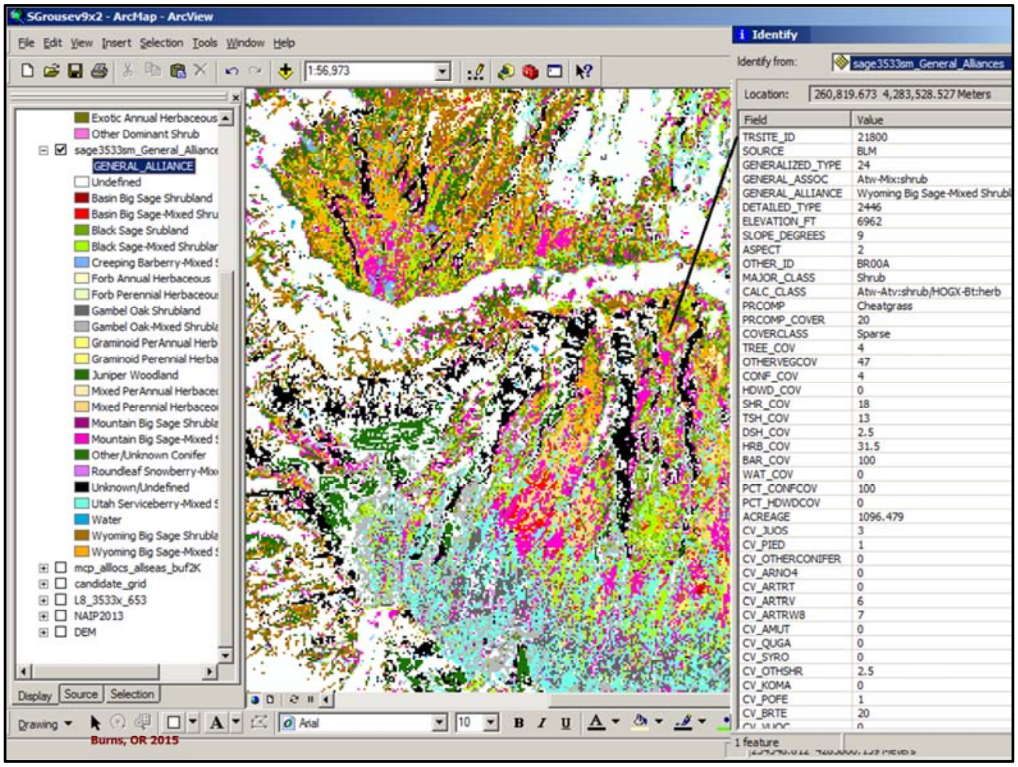
The end result is a map data set that supports the development of many maps and applications

This next map …



represents a color-coded map of the General Alliances found in this area.

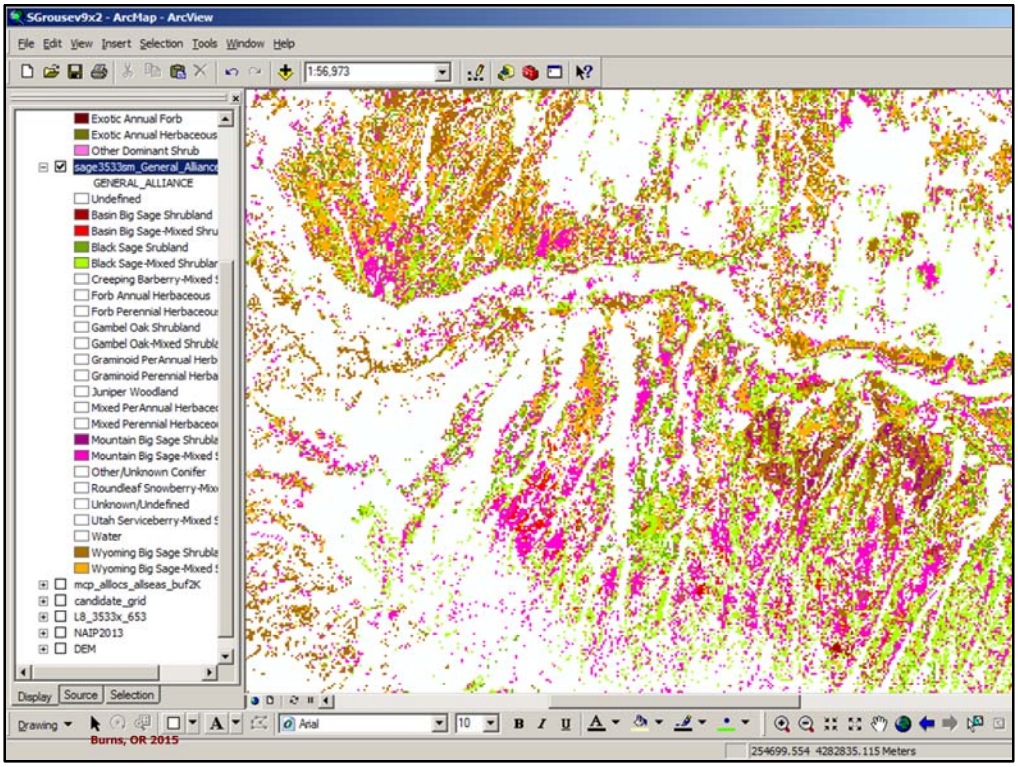
These Alliances have been based on the dominant/most abundant plant species and the presence/absence of a significant amount (25%) of other species.



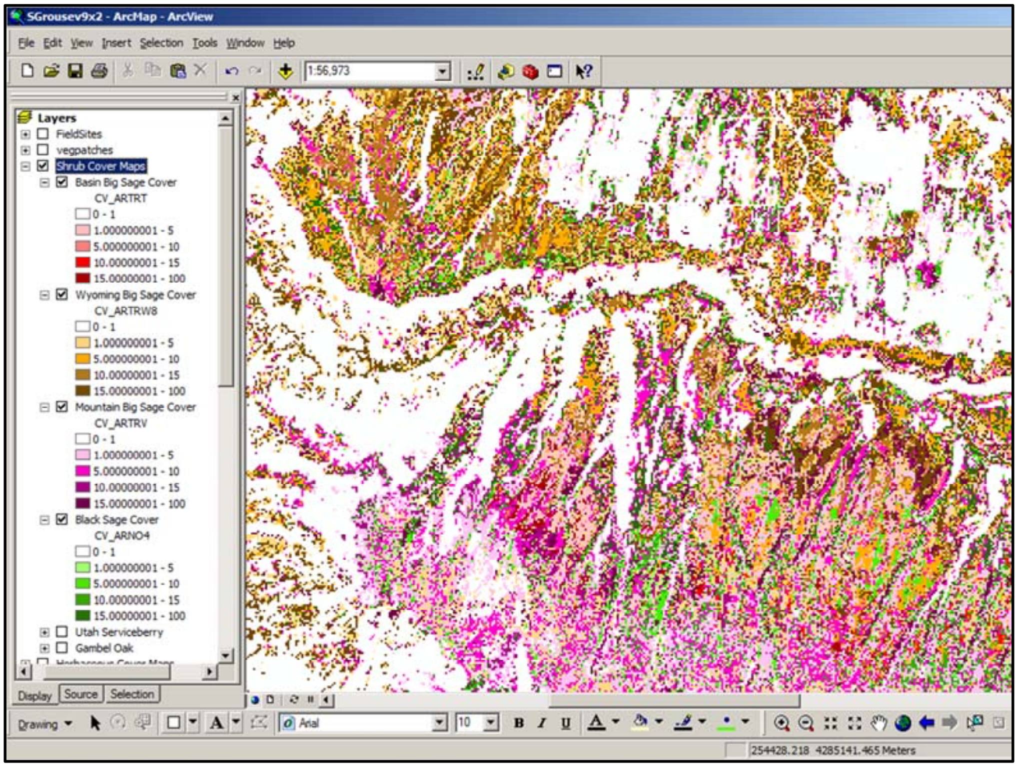
However, rather than this being simply a color-coded lookup table-based type map, every pixel is represented by a detailed set of attributes

that describe the plant community characteristics estimated for that specific location.

All of this information enables mapping of different types of plant community characteristics:



We can display the sagebrush types, by modifying our legend and blanking out the display of all the other types.



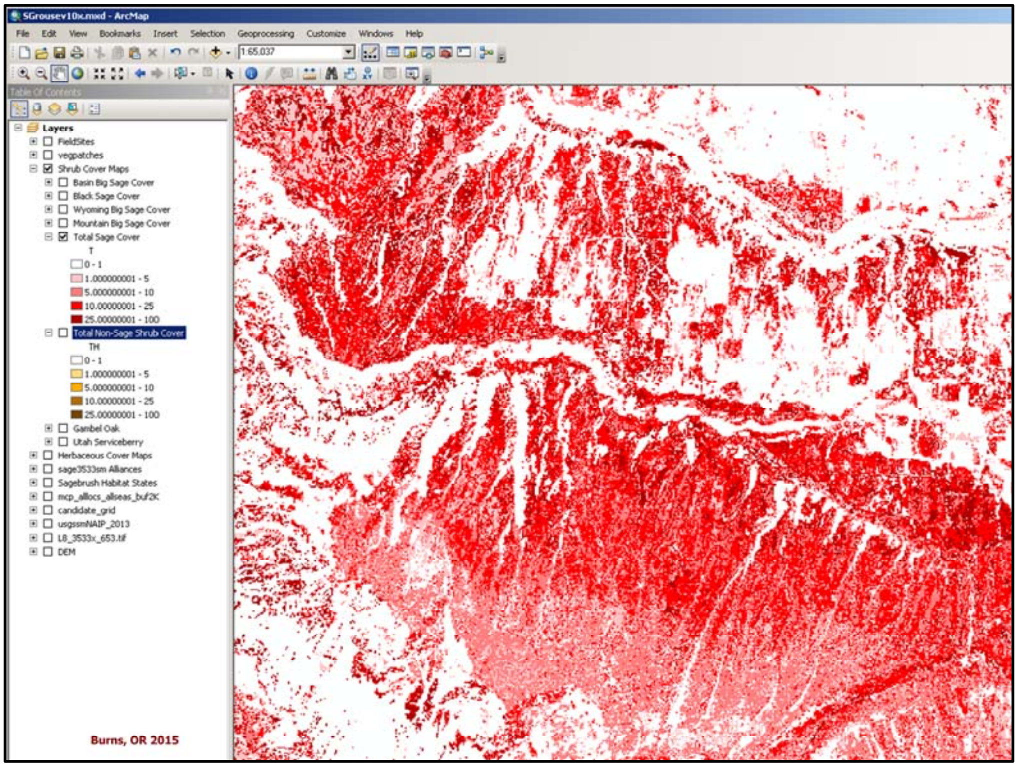
However, we can generate a different map for sagebrush species if we map Sagebrush Cover as a species cover component rather than by type. This map represents a different representation of sagebrush cover and extent than the sagebrush type map. It is not nearly as fragmented or spatially lacking in its distribution because we are mapping sagebrush cover for areas that may be other types than a sagebrush type, but they still contain sagebrush cover as a component of the other non-sagebrush type.

This representation of Sagebrush cover might lead us to develop different plans and policies than the previous apparently sparsely populated and fragmented shrub cover map.

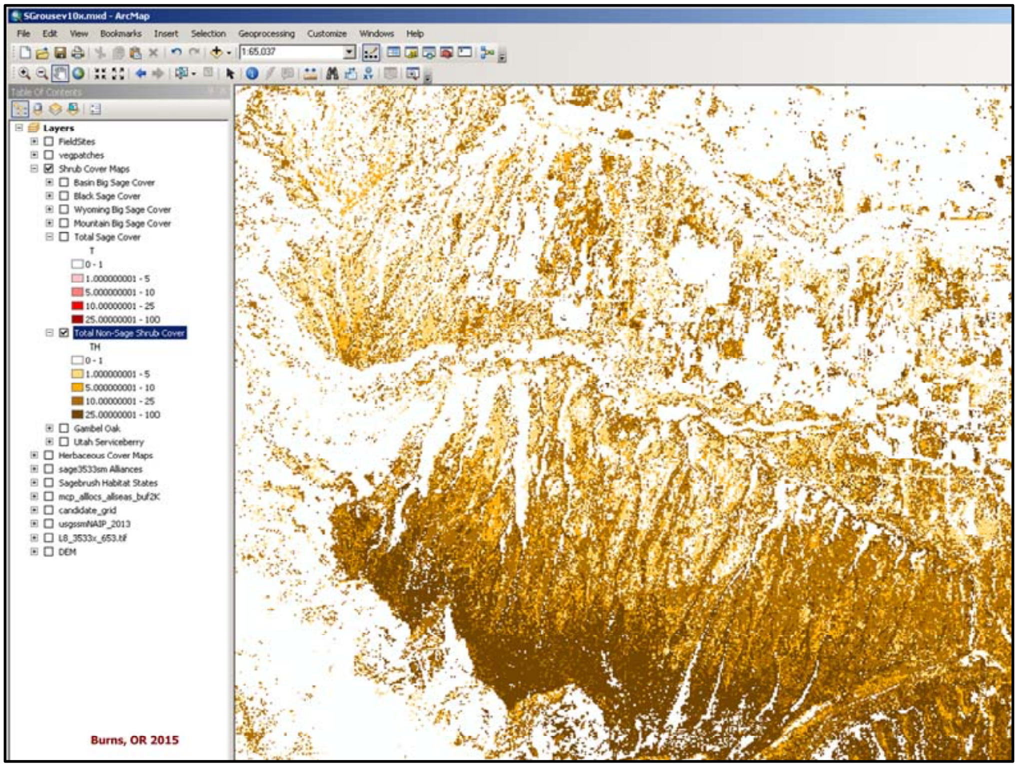
I would like to suggest that there is a better approach if you are interested in the presence of sagebrush cover rather than types, as the different sagebrush species may be a component of other "named" plant communities.

This map actually represents the combination of all 4 sagebrush species.

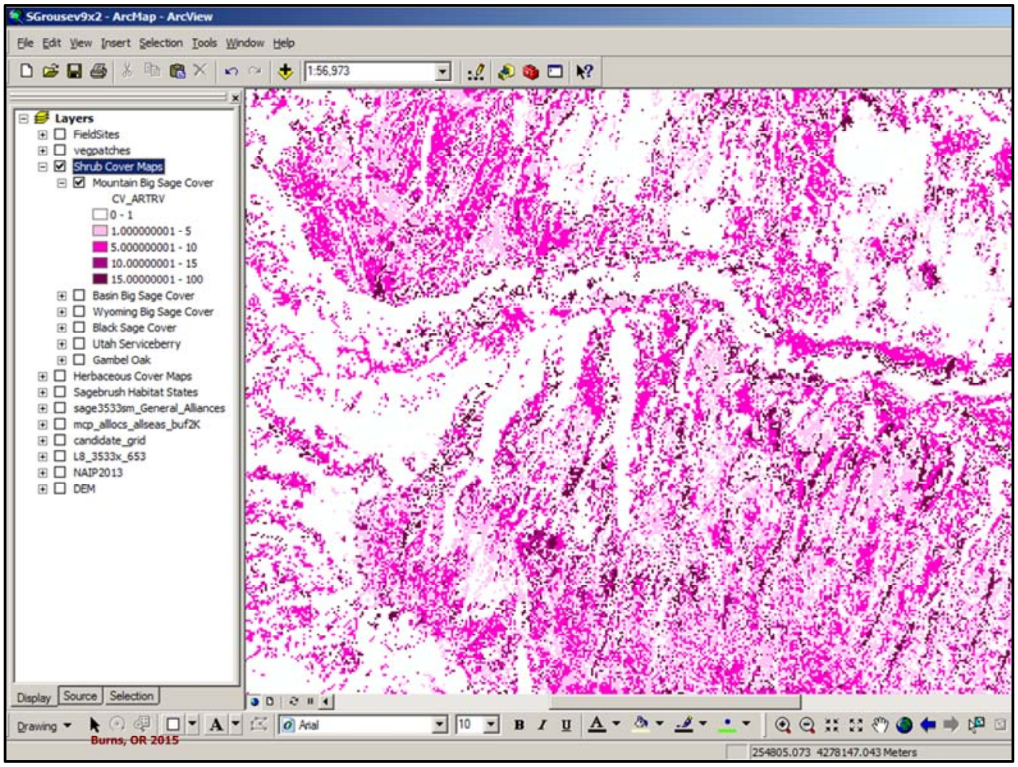
We can also map the total cover of sagebrush species cover individually …



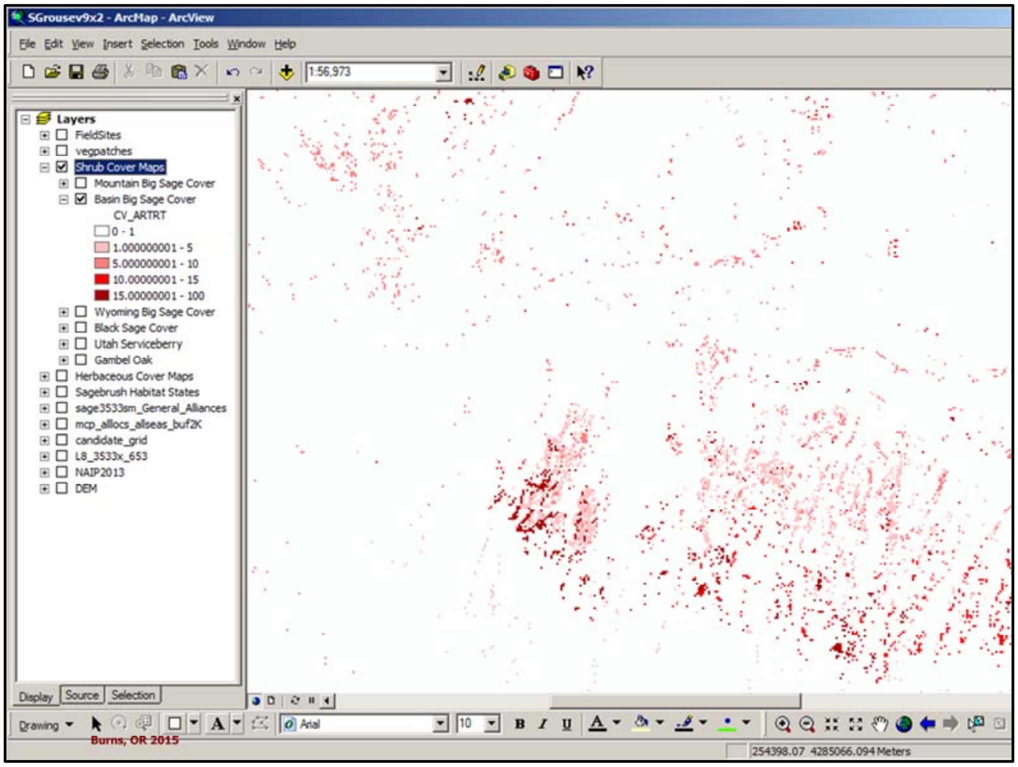
… the total cover of sagebrush species …



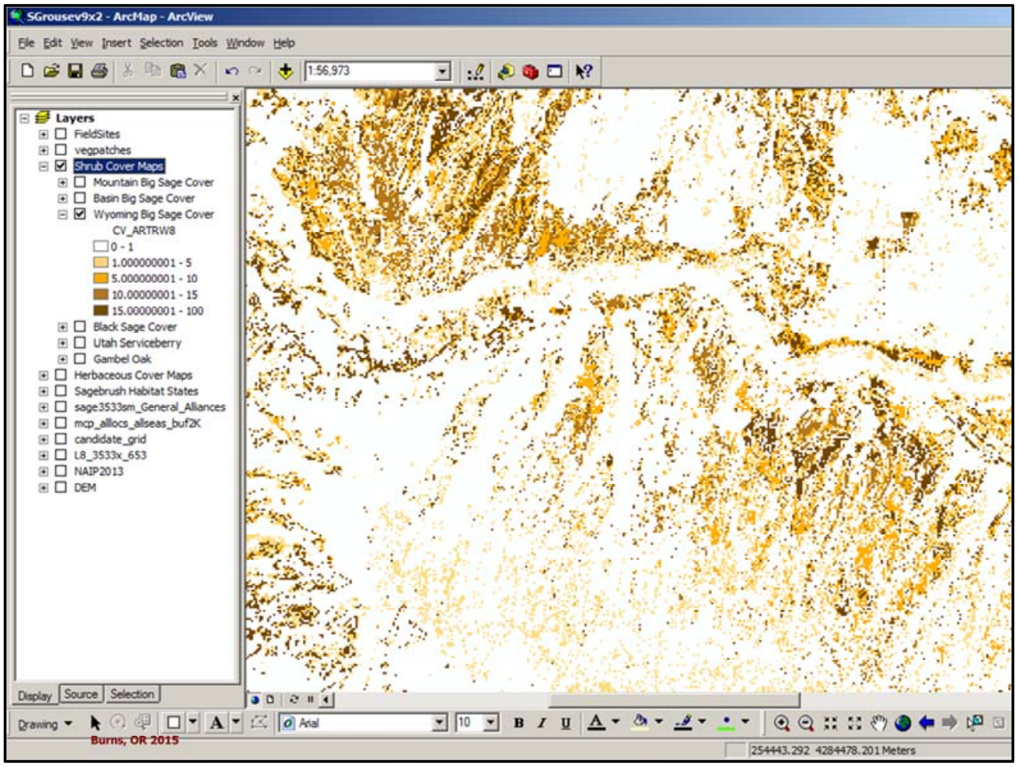
… the total cover of non-sagebrush species and individual sage species cover …


SGrousev9x2 - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
1:56,973
Layers
FieldSites
vegpatches
Shrub Cover Maps
Mountain Big Sage Cover
CV_ARTRV
0 - 1
1.000000001 - 5
5.000000001 - 10
10.00000001 - 15
15.00000001 - 100
Basin Big Sage Cover
Wyoming Big Sage Cover
Black Sage Cover
Utah Serviceberry
Gambel Oak
Herbaceous Cover Maps
Sagebrush Habitat States
sage3533sm_General_Alliances
mcp_allocs_allseas_buf2K
candidate_grid
L8_3533x_653
NAIP2013
DEM
Display Source Selection
Drawing
Burns, OR 2015
Arial
10
254805.073 4278147.043 Meters

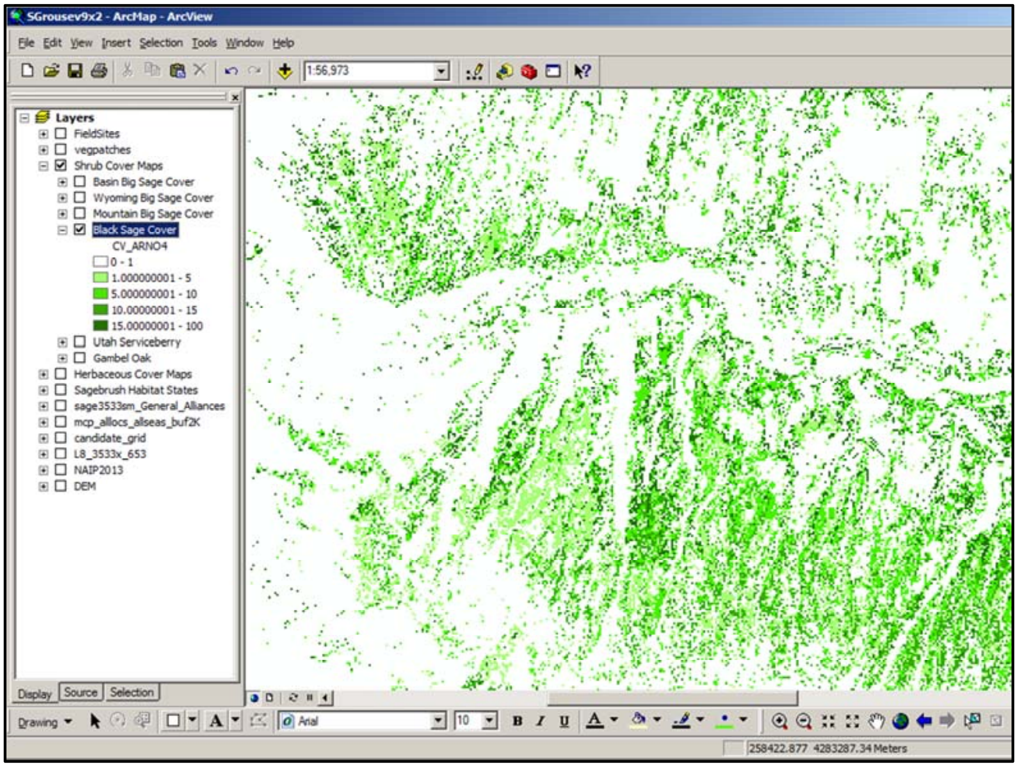
… Mtn. Big Sage



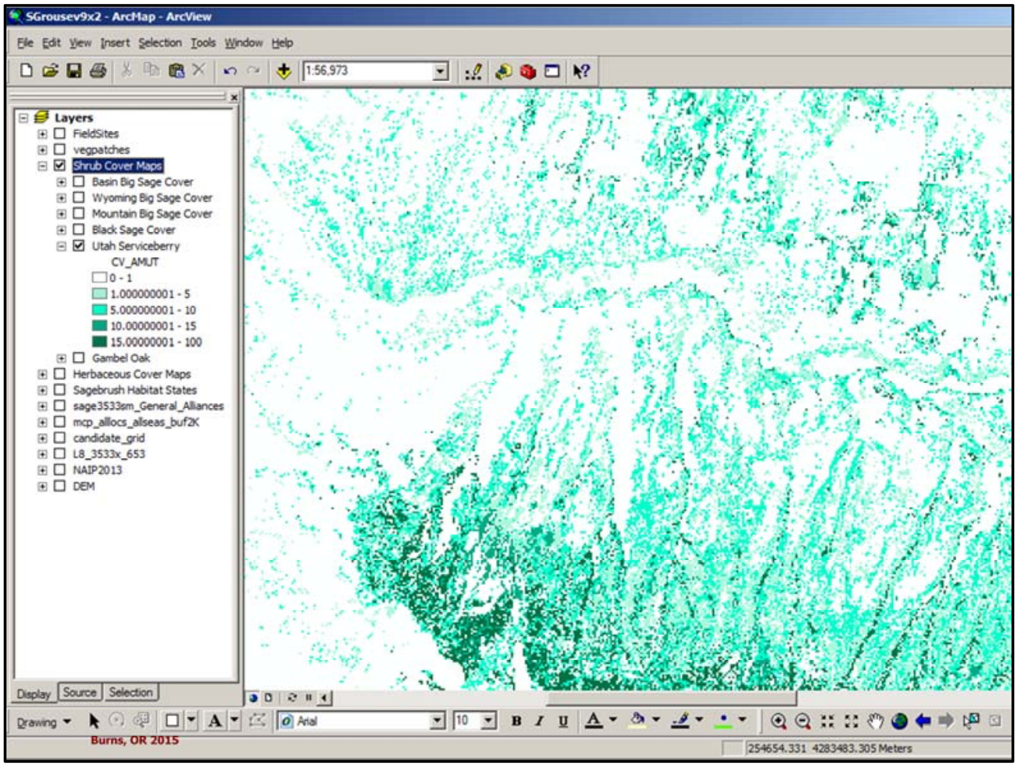
… Basin Big Sage



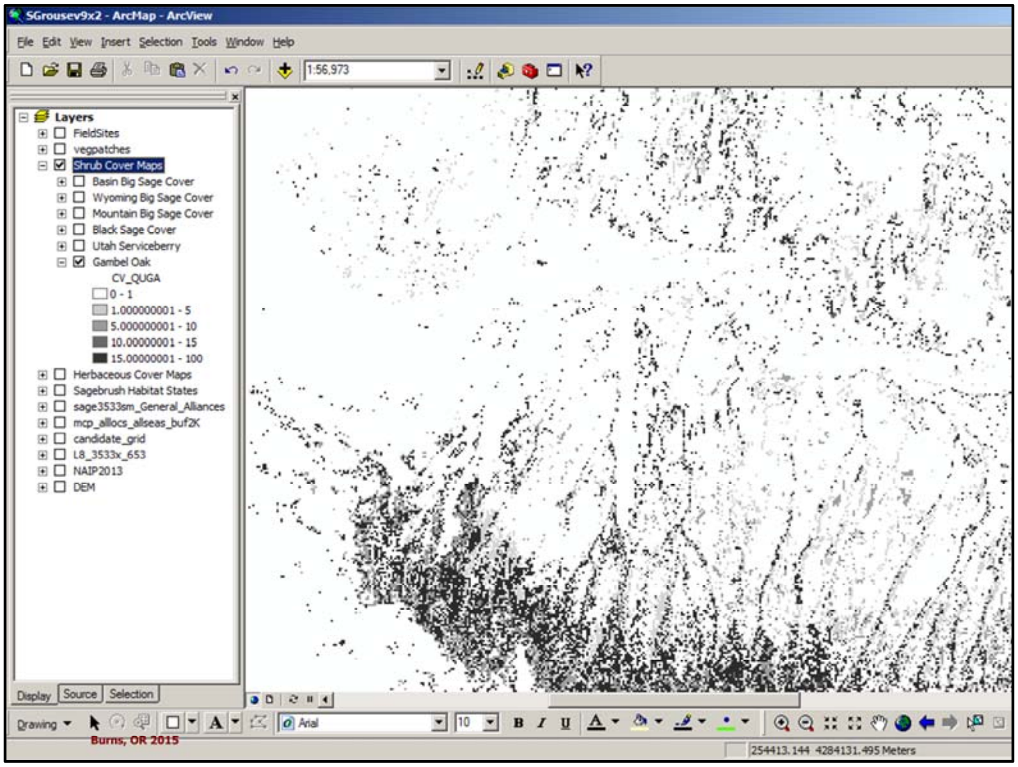
… Wyoming Big Sage



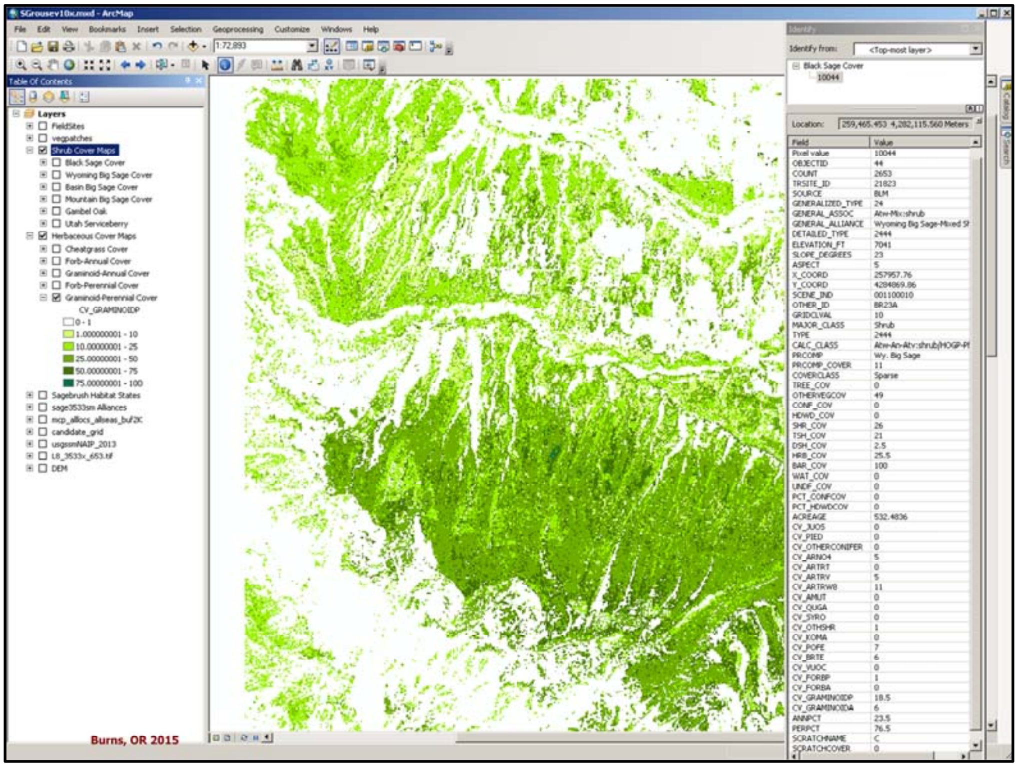
And Black Sage



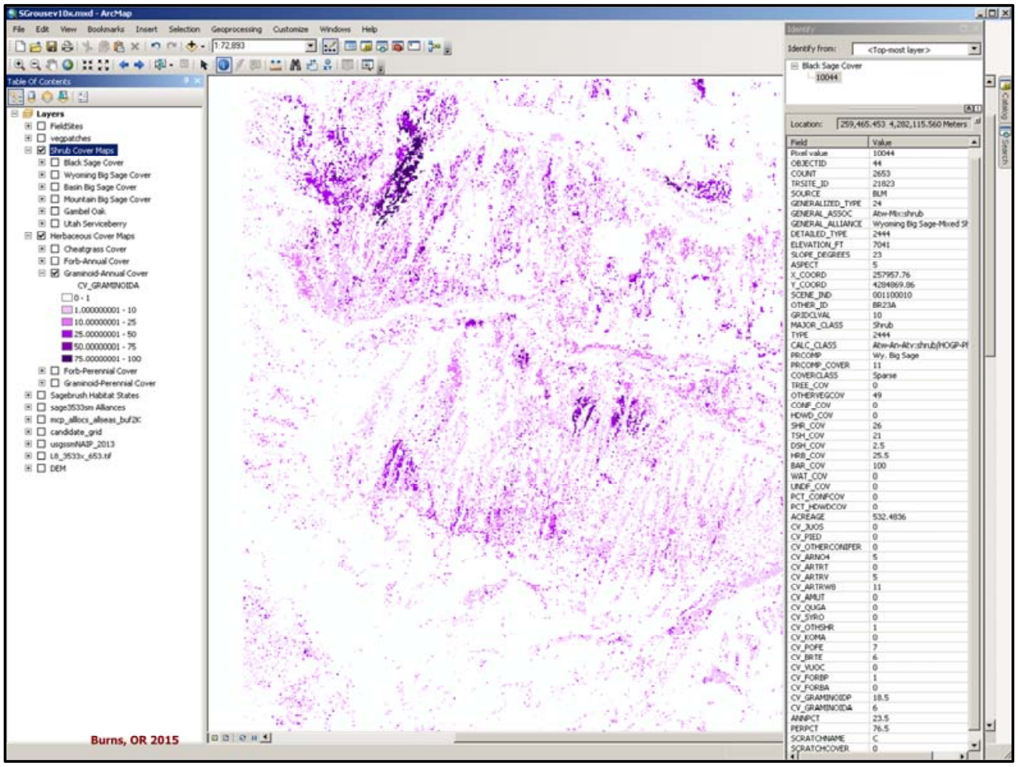
We can also map other species and features … like Utah Serviceberry or



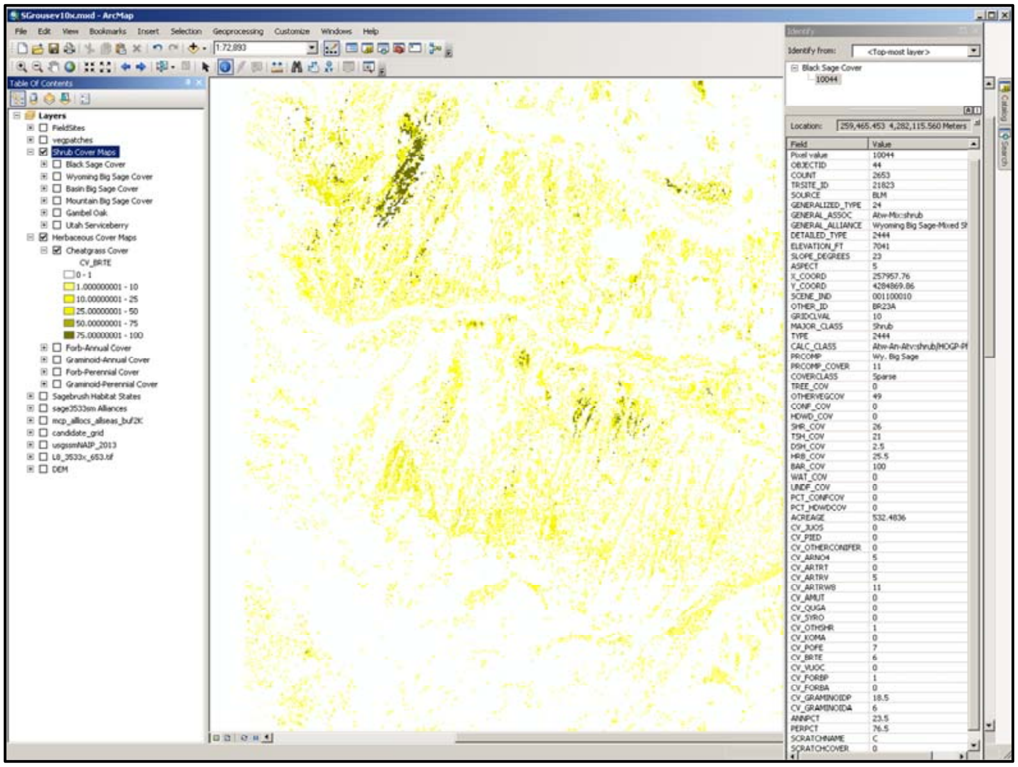
Gambel Oak, both of which tend to occur at predominantly higher elevations than do the sagebrush species.



Here is a map of Perennial Graminoid cover and

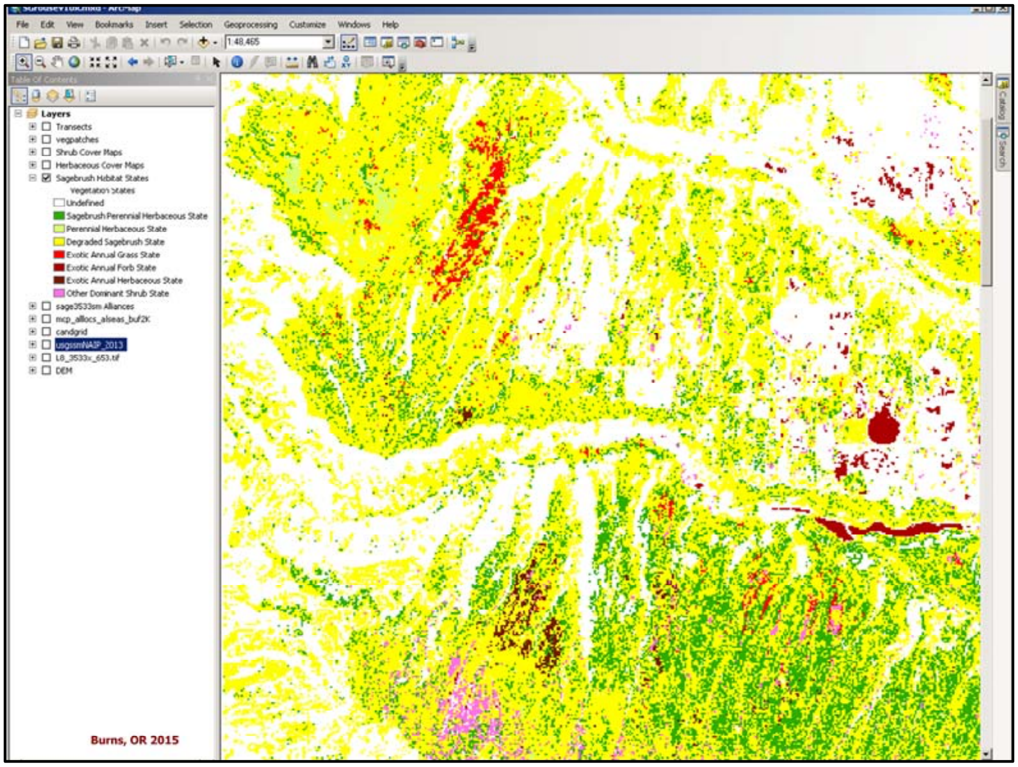


Here is a map of Annual Graminoid cover … and

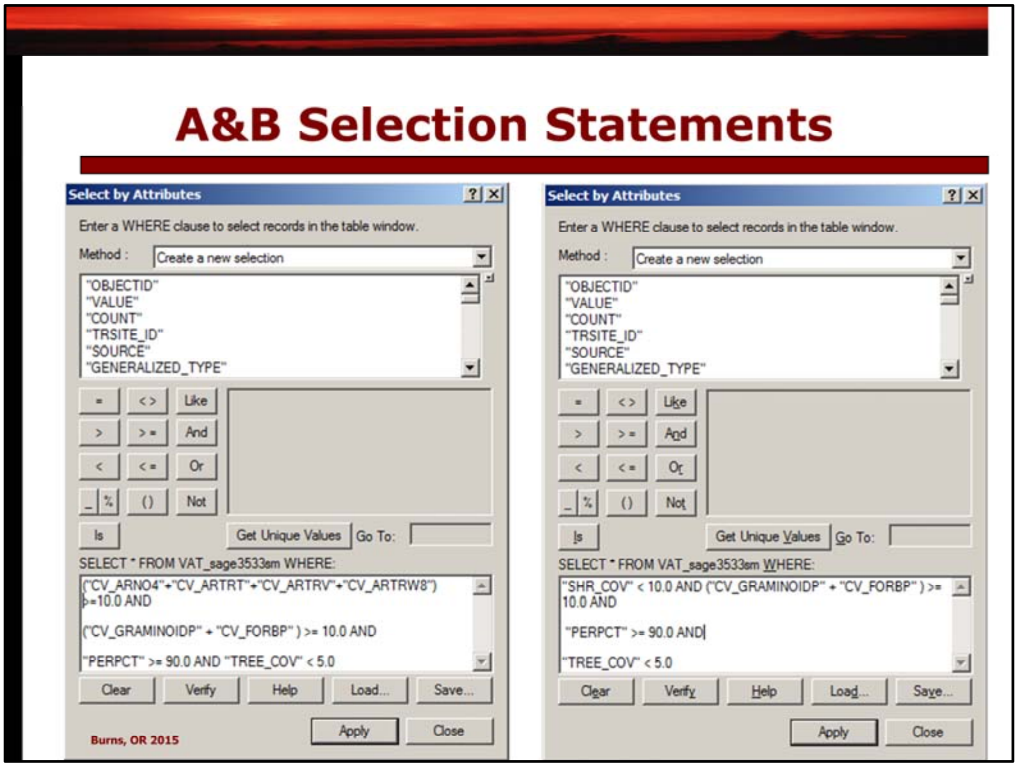


Here is a map of Bromus tectorum cover …

We can use these maps to develop other information …

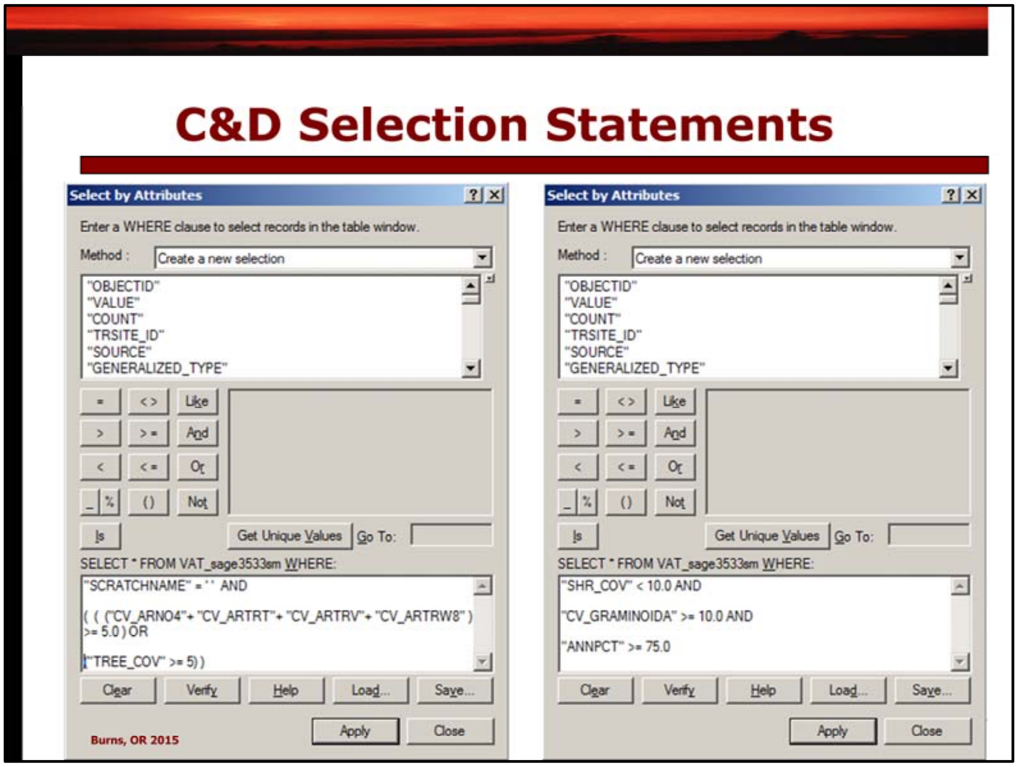


Use this data to map Sagebrush Vegetation States …

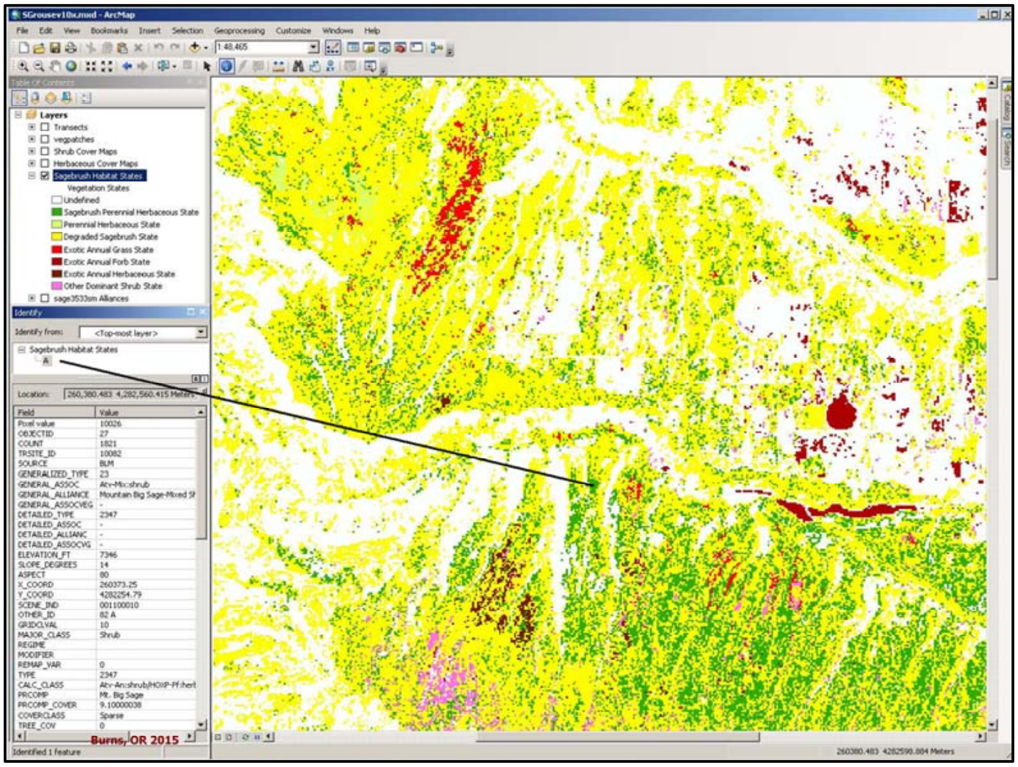


We can select records based on cover rules and threshold and update a “State” field to represent the Vegetative State of a location.

Here are selection criteria for States A & B.

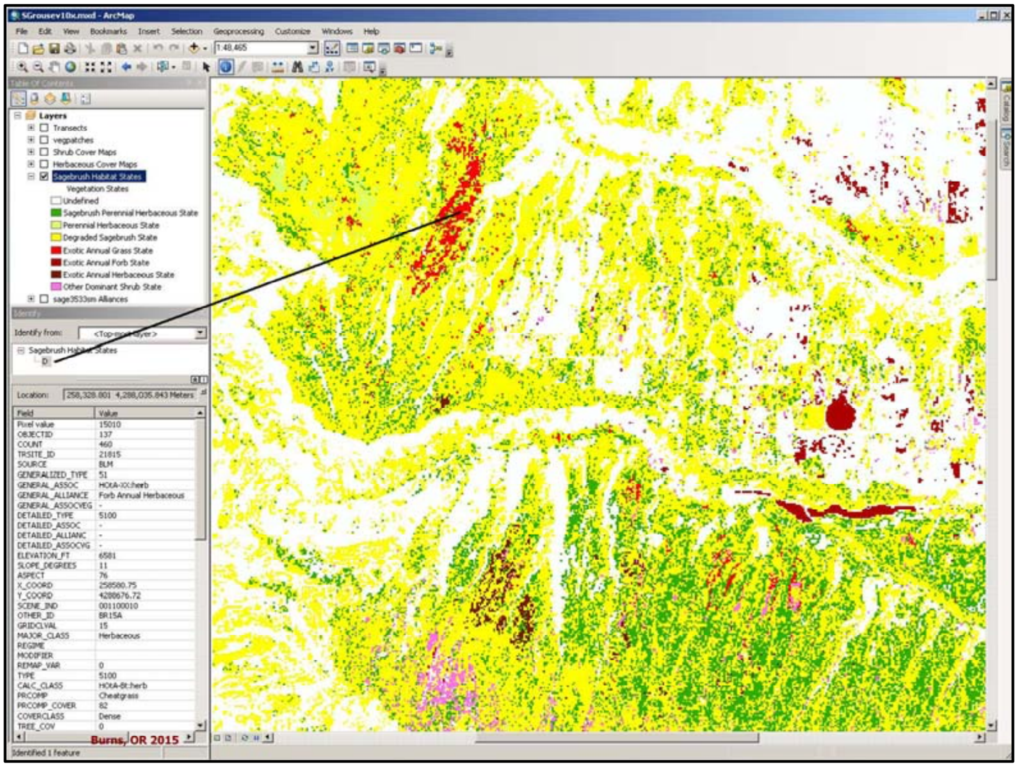


Here are selection criteria for States C & D.



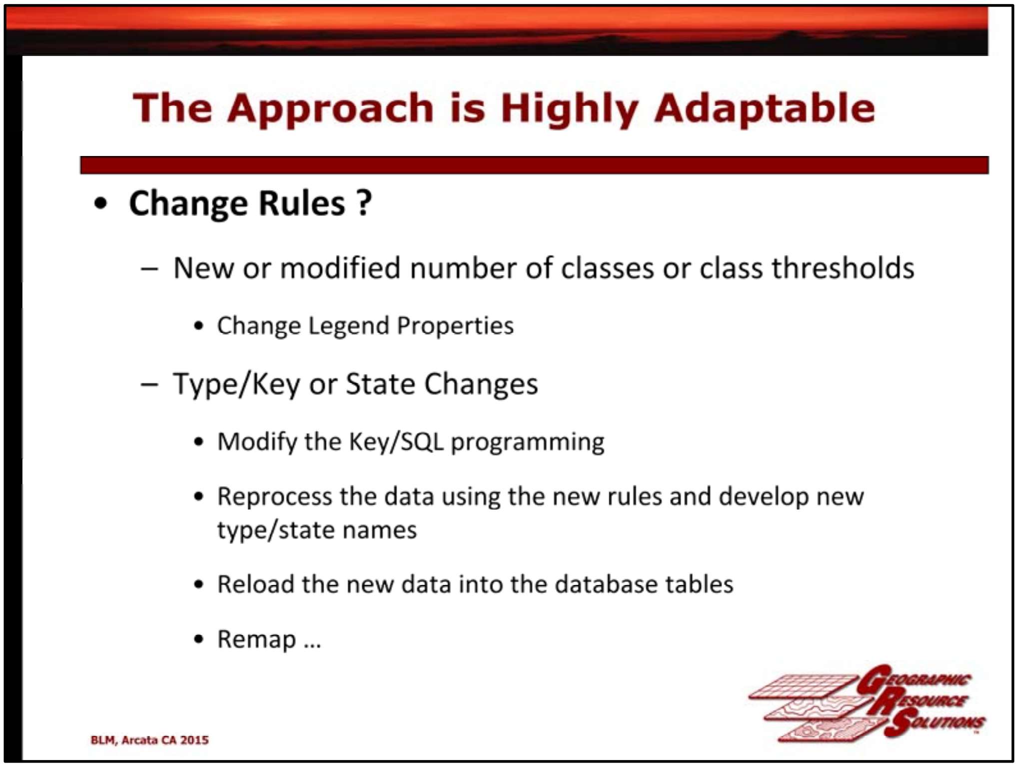
Here is an example of the Vegetation States layer we can develop based on these rules as applied to the database attributes that have been mapped …

This is an example State A - rules indicate assign State A when Sagebrush > 10% and annual herb < 10% and tree cover < 5%

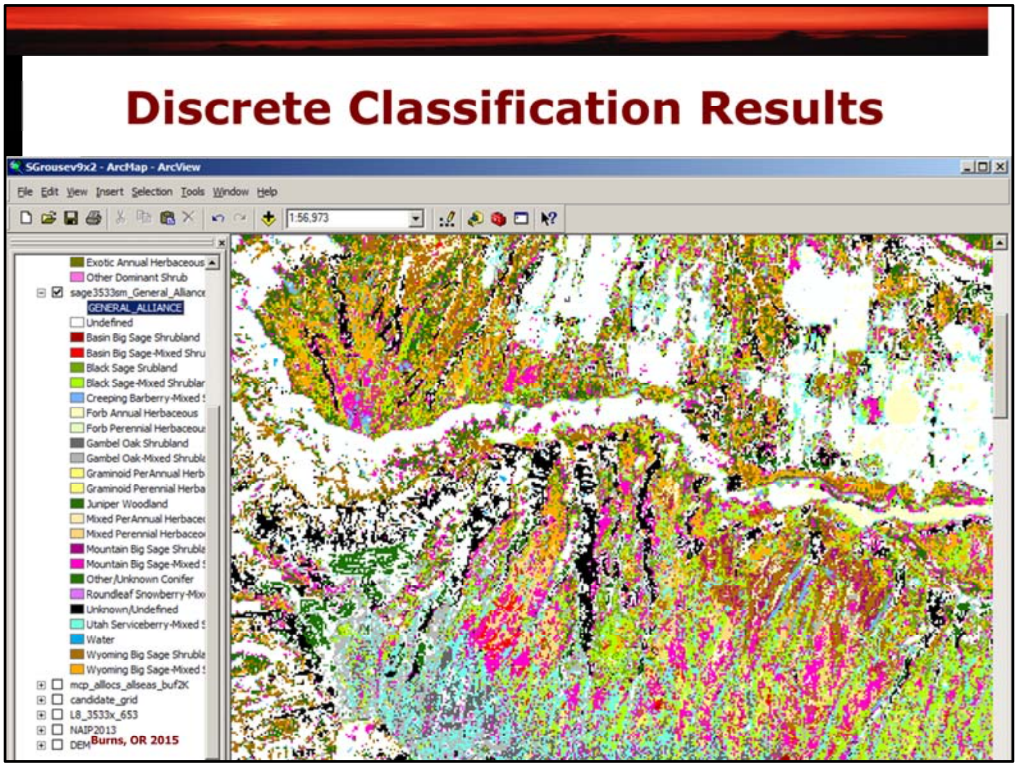


We can change rules and thresholds …

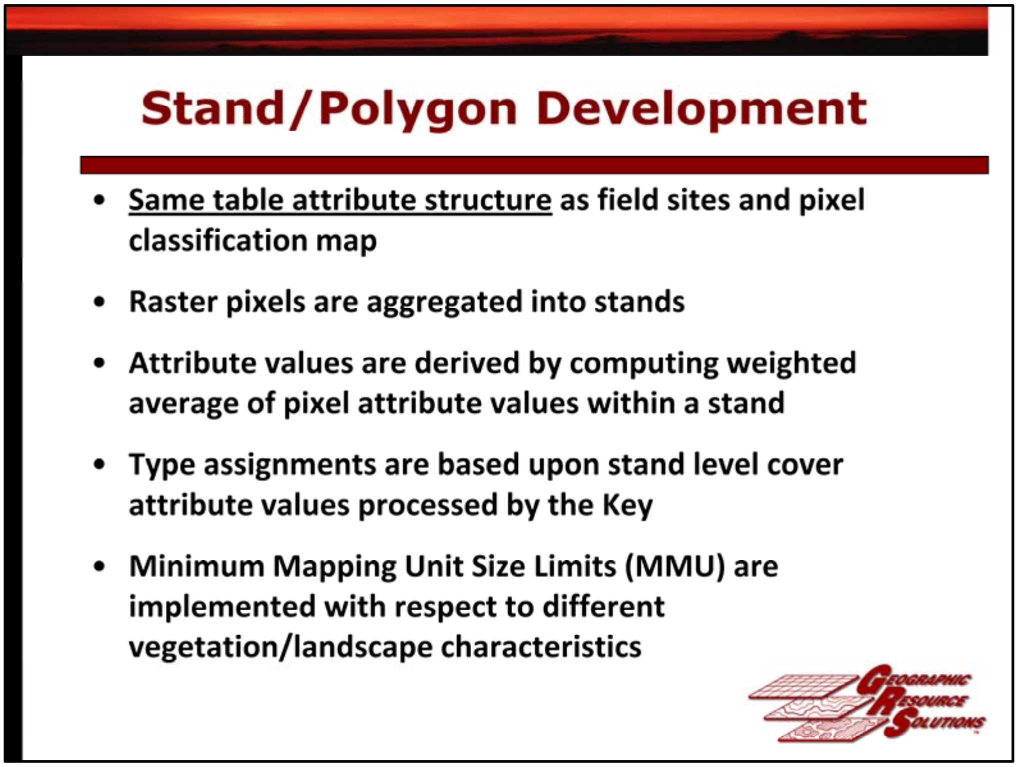
State D = < 10% sage and Bromus Tectorum >= 75%



A key benefit of this approach is that different results are easily generated as it is easy to modify/generate new categorical class (State) values based on different rules.



The end result of the Vegetation/Image Classification process is the DCMM data set …



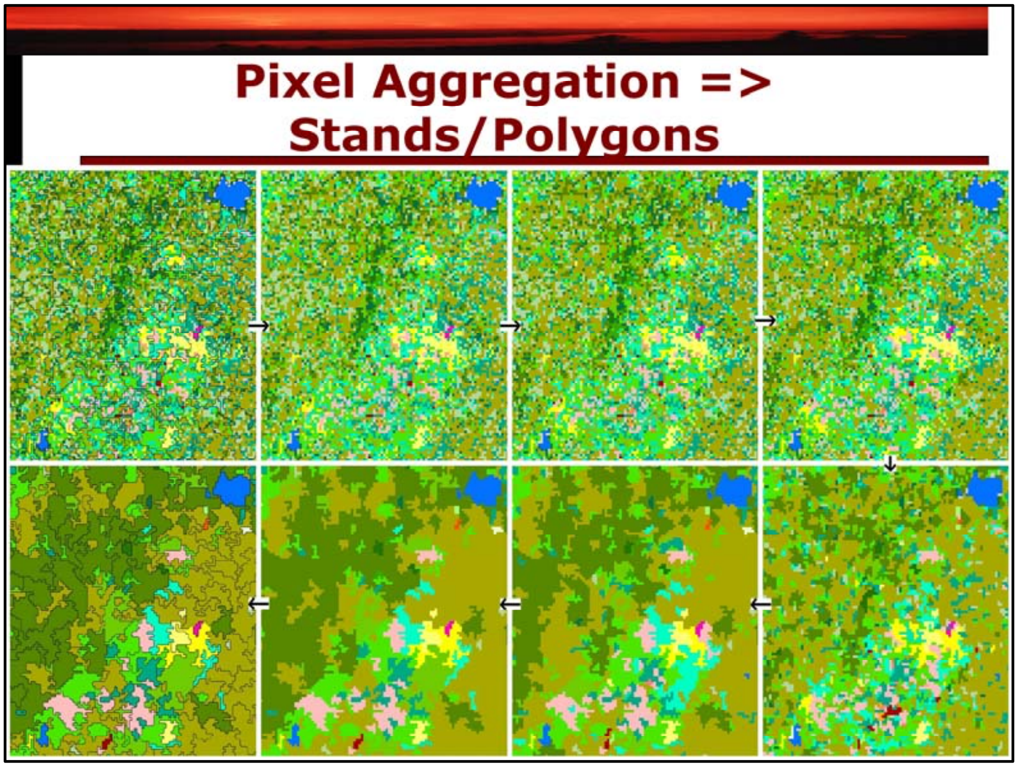
This data set has the same table structure as the field sites

We can use it to perform Pixel Aggregation

The resulting stands have attributes based on the weighted averages of all pixels merged together into a particular polygon/stand.

We can process the stand attributes to assign Type names

We can implement different MMU values, based on the relative significance of the different species

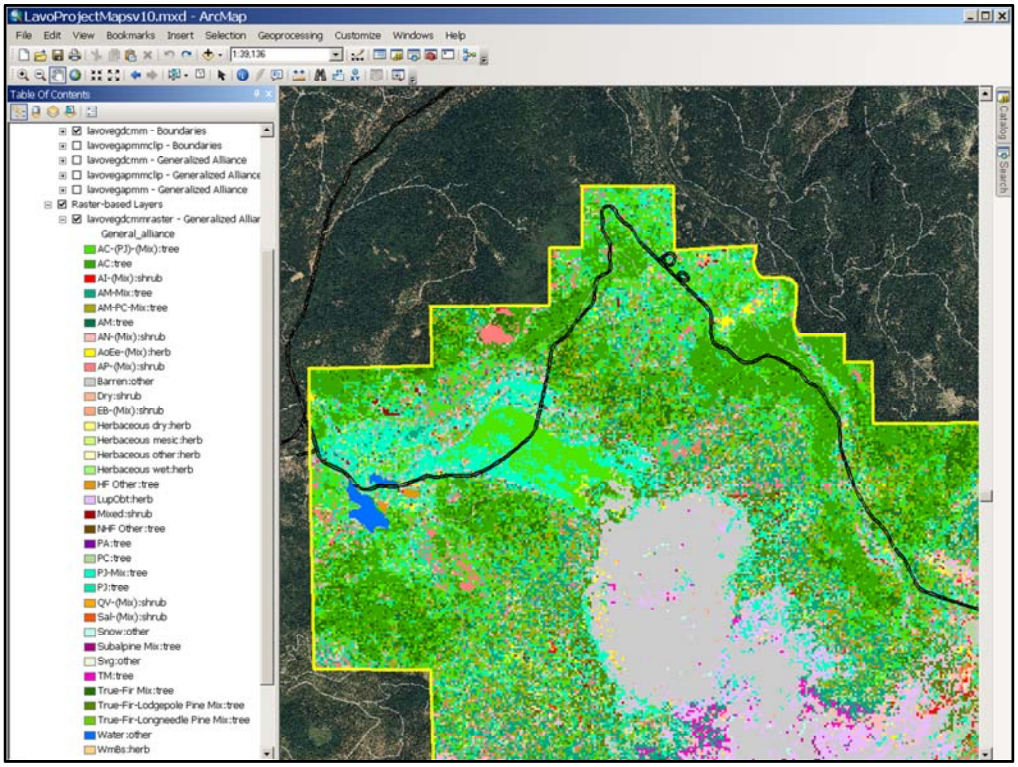


Here is an example of the pixel aggregation process using a display from our recent LAVO Project.

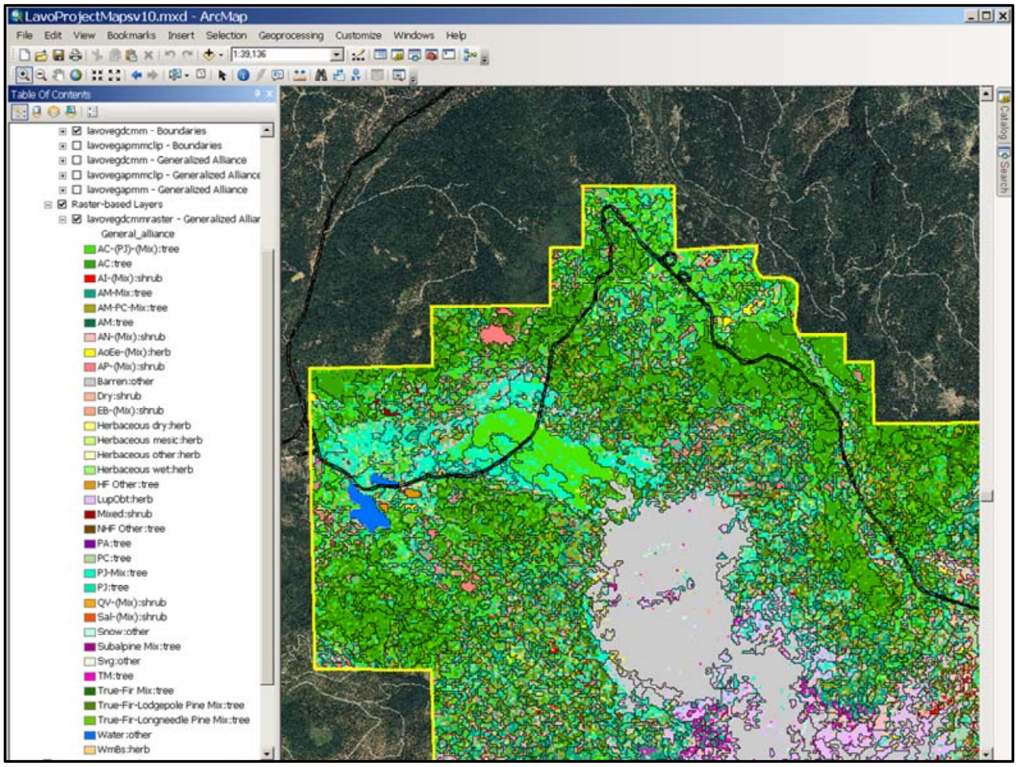
We use the detailed species-specific cover data to form groups of “similar” and dissimilar pixels that will eventually form stands, which all meet the minimum mapping size limit.

This figure shows the aggregation results at different levels as we process all the data and aggregate the pixels into polygons.

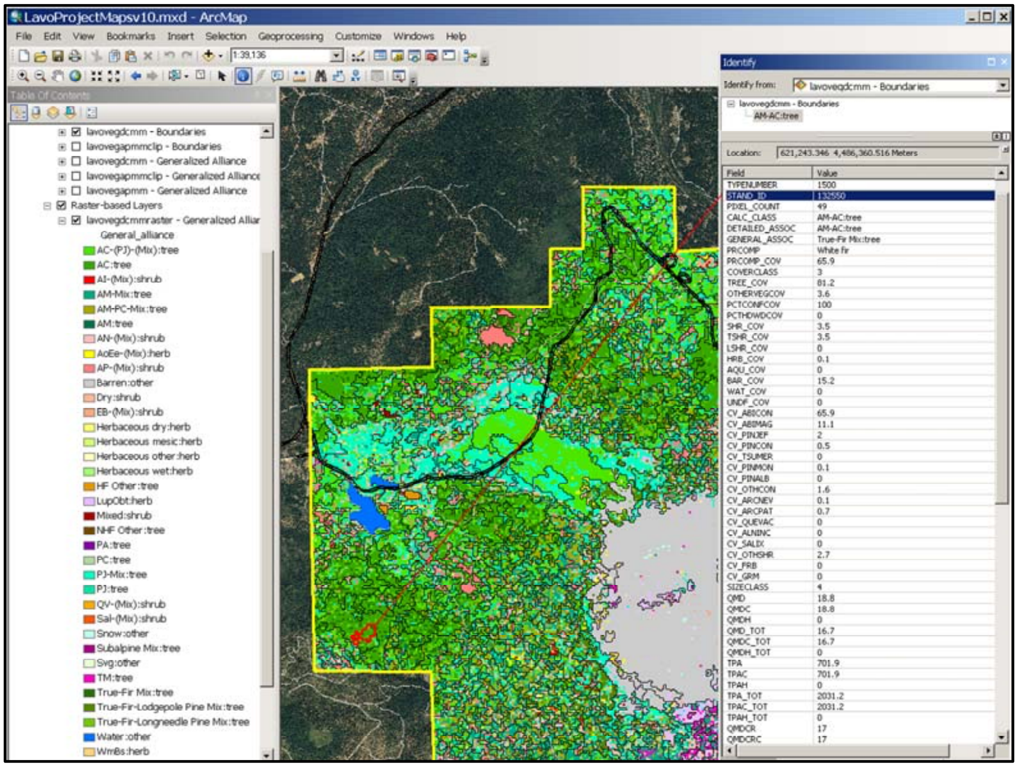
(This step can be replaced by using the boundaries created using an object oriented classification approach, but I think this approach is better as it is based on plant community characteristics rather than spectral data). It can also be replaced using hand drawn photoInterpreted boundary linework.



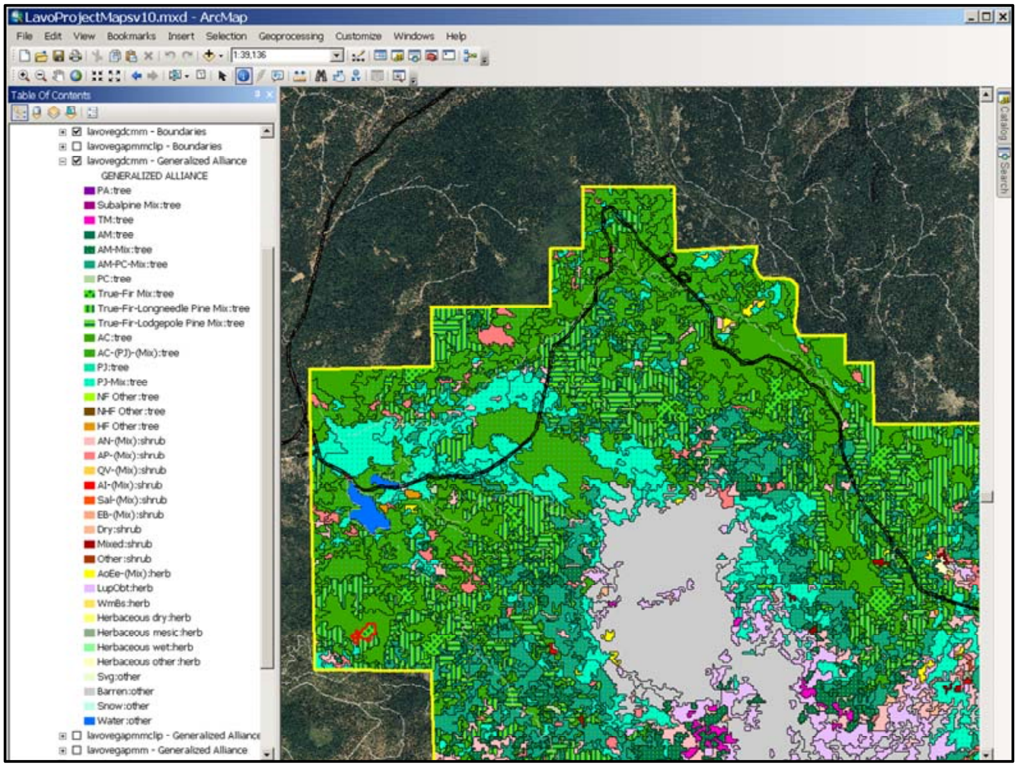
Again, using our recent LAVO project – this Raster classmap represents the starting point of the aggregation process…



Here are the resulting stand boundaries displayed over raster map …

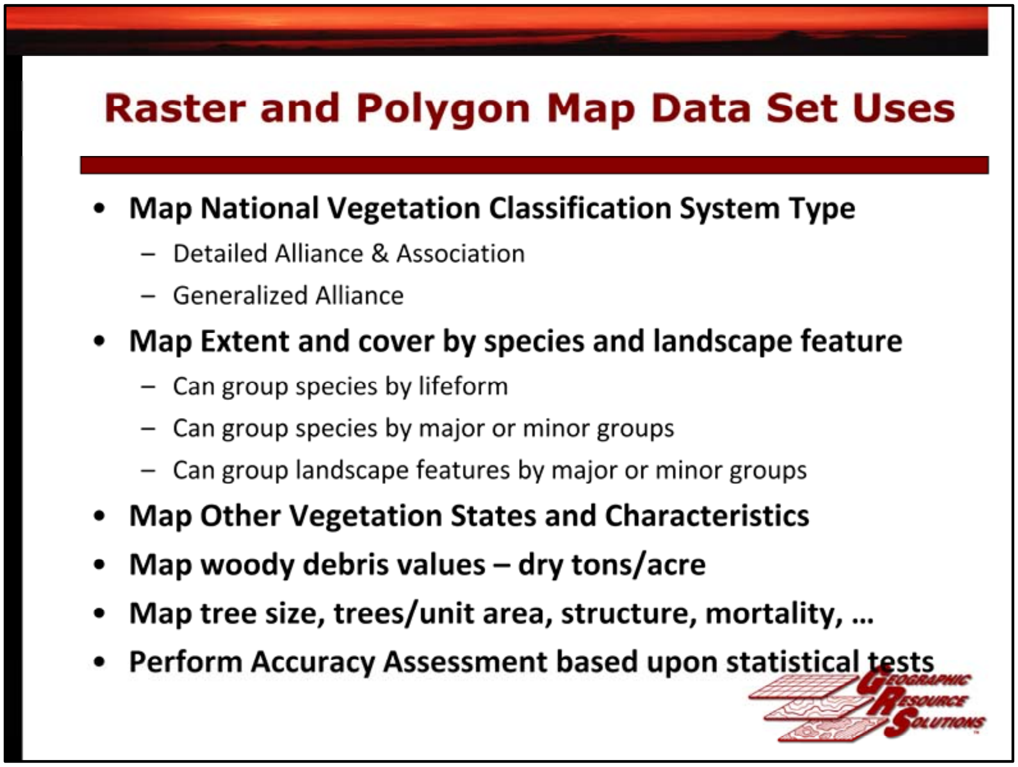


This slide shows some of the attribute info at the stand level …



This slide shows the Stand map symbolized by Alliance/Landscape feature

For LAVO, 870 classes were generalized to 37 Generalized Alliances



The resulting Stand Level Map Data Sets have numerous uses …

They meet the NVCS Type name requirements, but in addition can be used to map:

The extent and amount of cover of different species and landscape features,

A Vegetation State,

Size characteristics,

And other characteristics, such as estimates of woody debris and biomass by size class …

Lastly, accuracy assessments may be undertaken using statistical tests rather than “fuzzy logic”.

Let’s look at some examples …

Over the past 25 years our mapping methodology has evolved from it's original form as it seems like we **encountered new challenges and processing obstacles**.

Initially it was lack of Memory and disk space

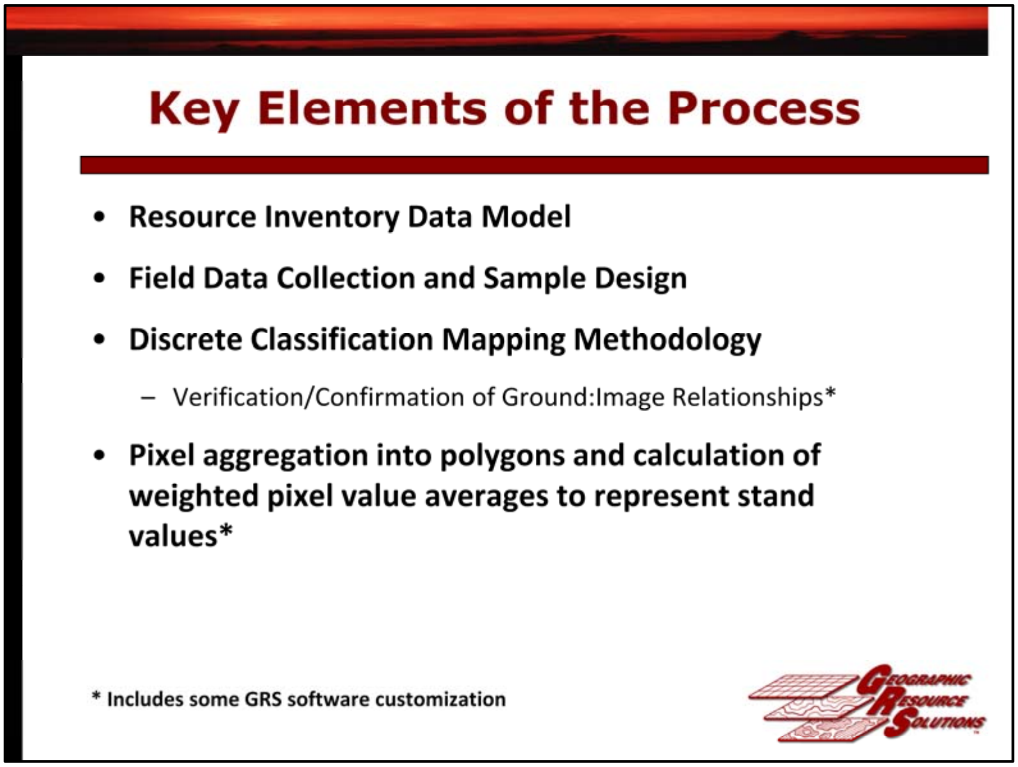
Had to be creative ... Like stuffing 5 different data items into the different bits of one 32 bit integer so I didn't exceed the computer's memory ... (simvals)

A mB of memory was $1K

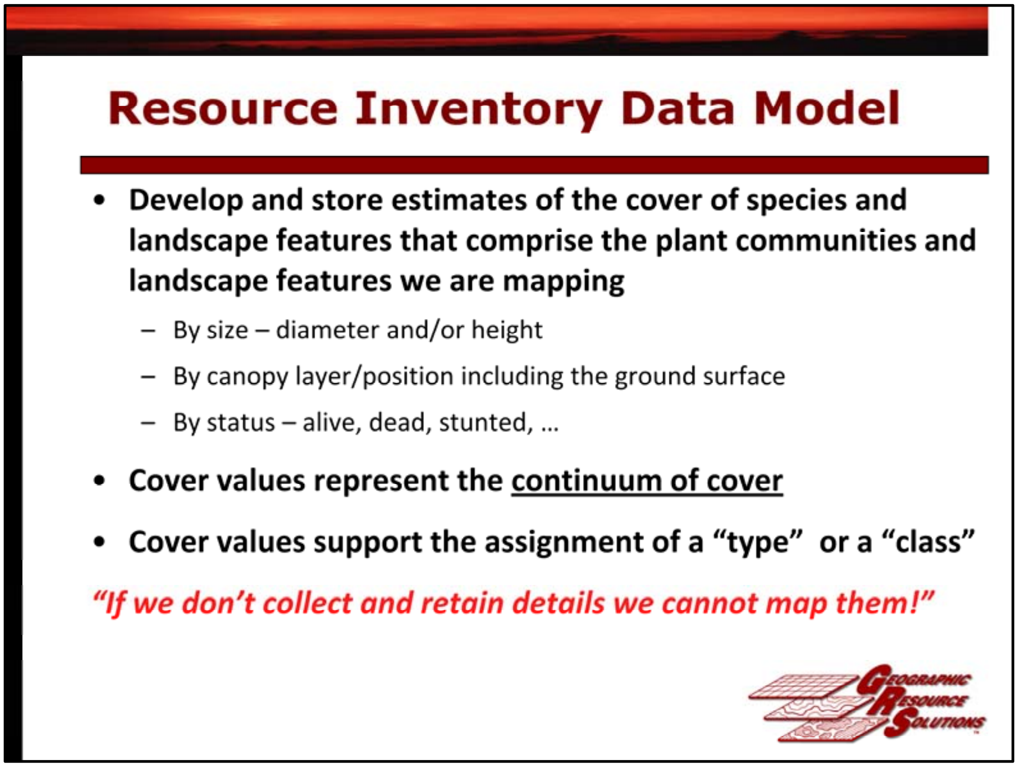
It took 10 days to perform classification of one image, something that takes 15 minutes on this laptop;

A 2 gB external drive cost$4K.

Our approach evolved with respect to the information content, field sampling techniques, and data processing tools to take advantages of the changes in technology that have occurred.

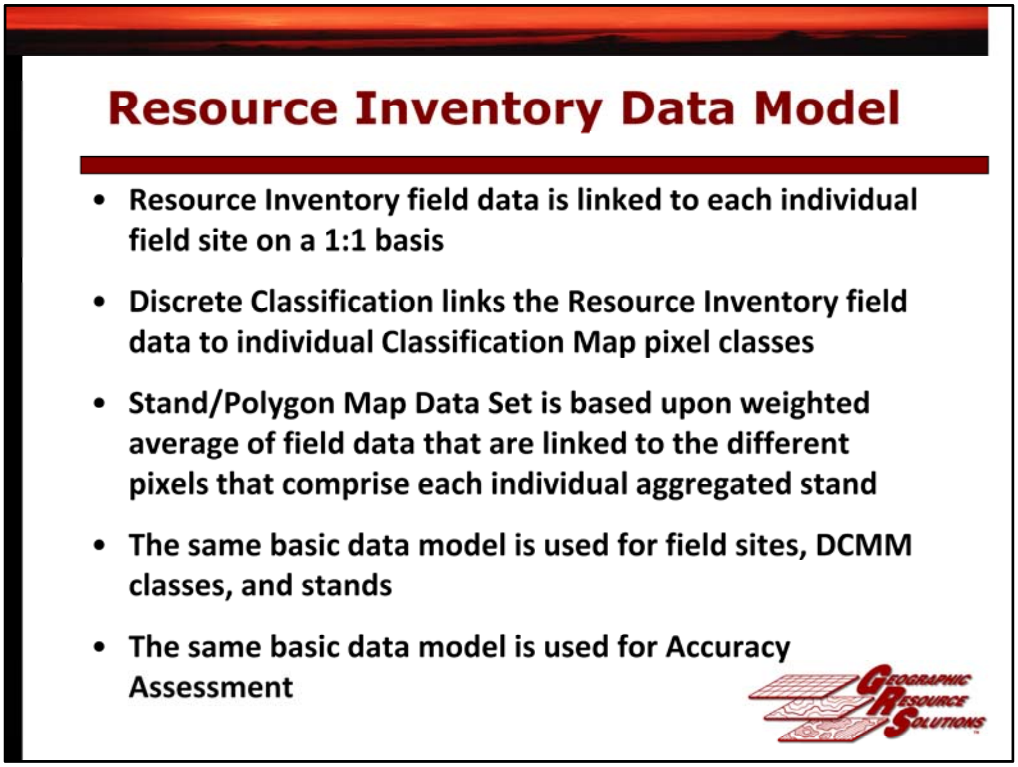


So now let's look at the key elements of our process (See slide) …



We use a different data model based on collecting and storing species or landscape feature specific cover estimates by size, canopy layer, and status.

Splitter and then a lumper !

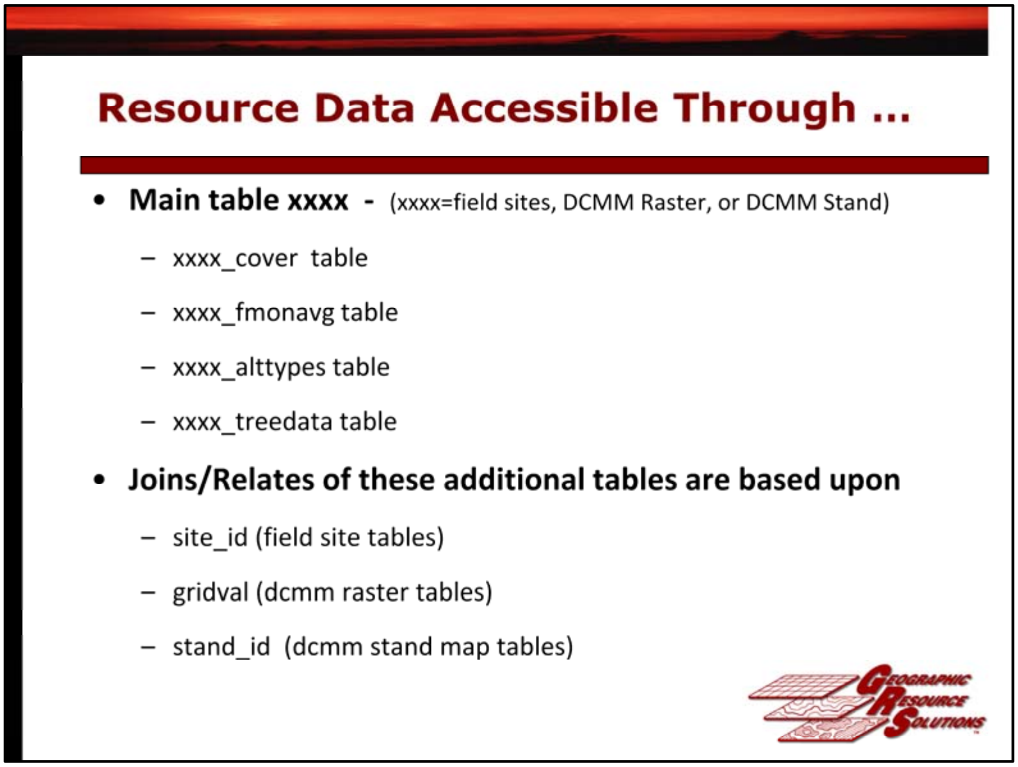


Resource Inventory data are developed for/represent the individual field sites

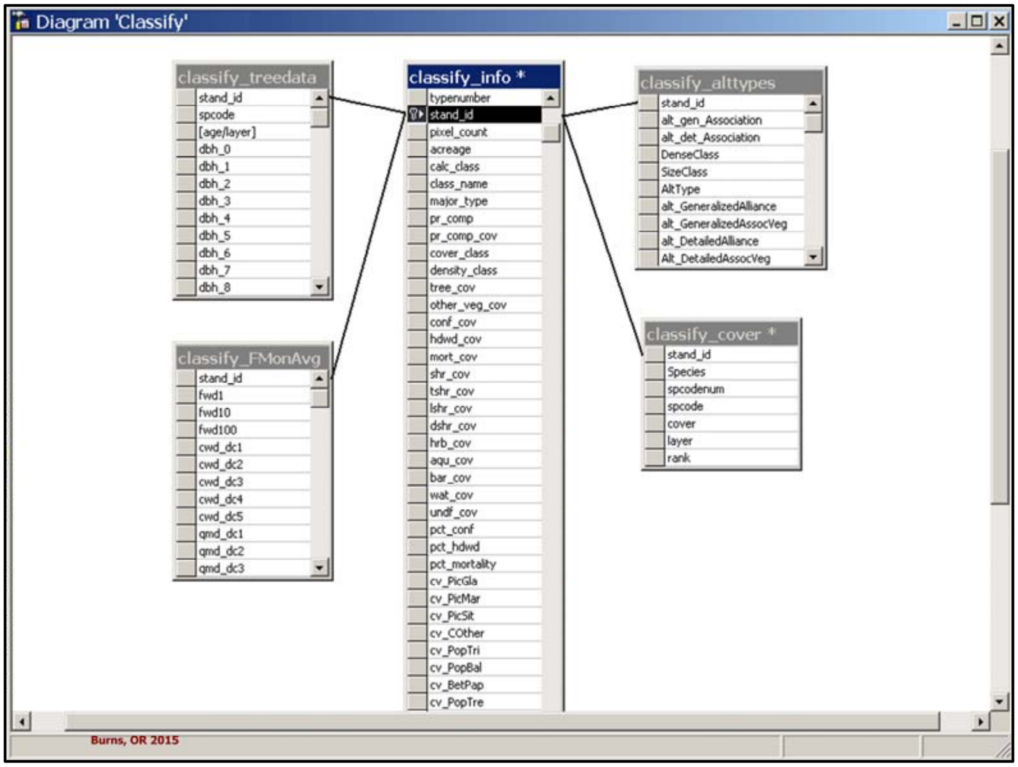
The Discrete Classification Mapping Methodology links the Field Sites data to individual Pixel Classes

The Stand values are based on weighted average of Pixel Class values

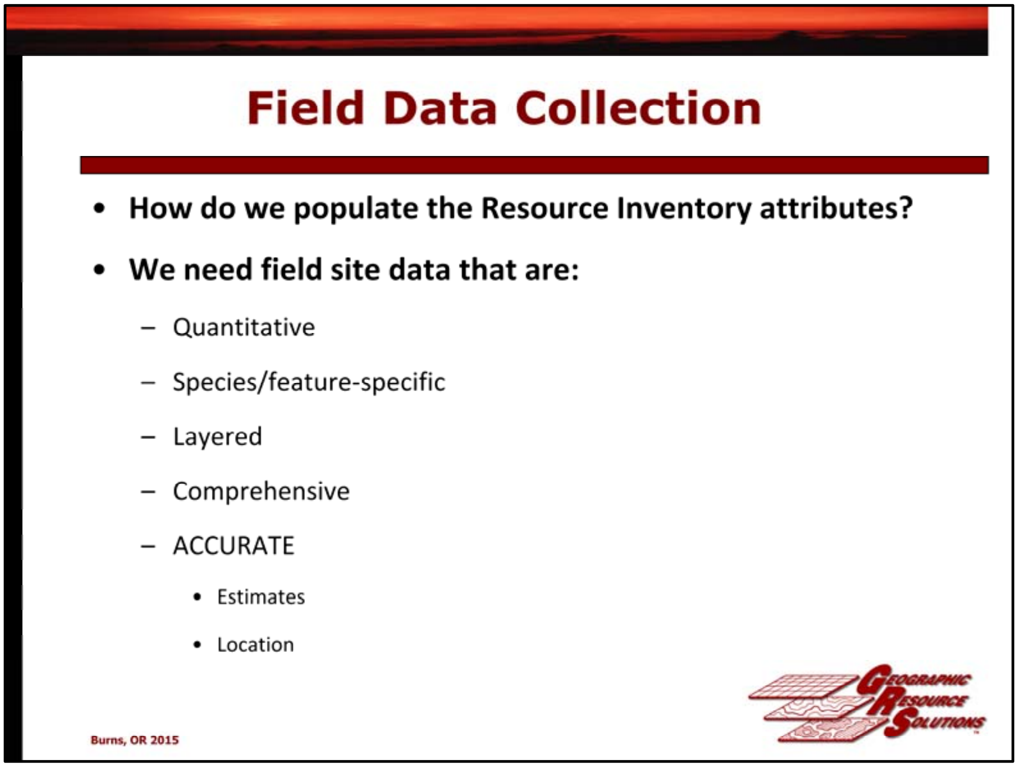
The same basic data model is used for field sites, DCMM classes, and stands



The data structure is somewhat similar to the DOI PLOTSv3.2 but extends to the raster and stand map data sets too, instead of just the field data.

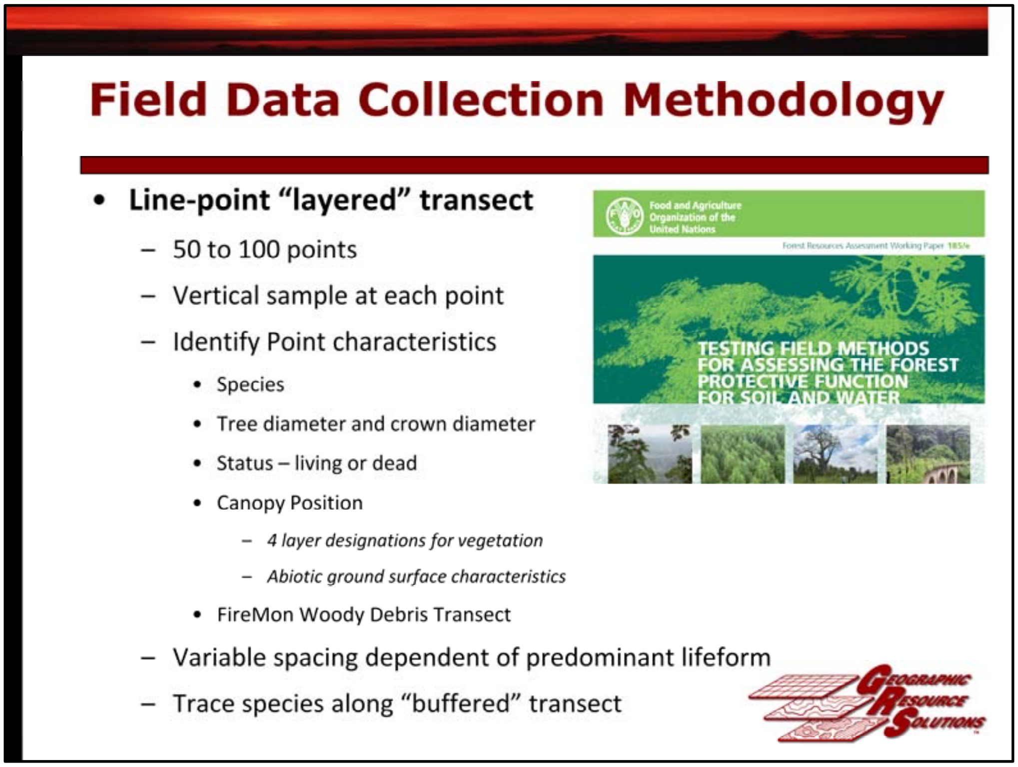


At the stand level the database table relationships look like this

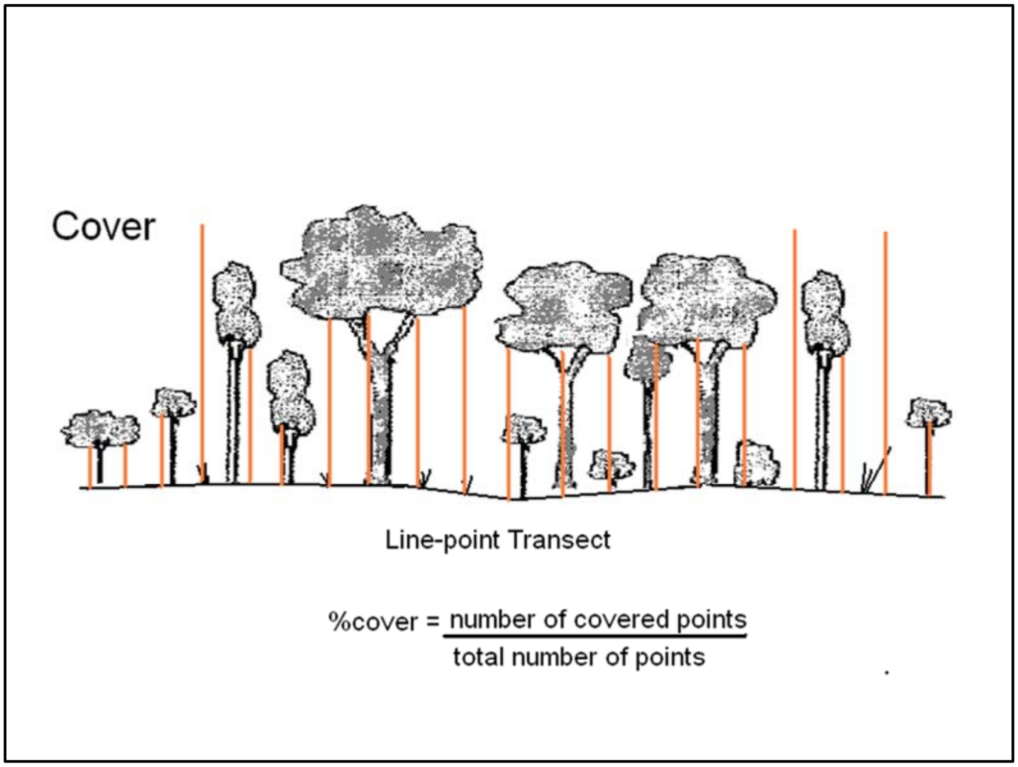


Past projects have used DU, NPS FirePro, ANHF, ABR, RA/Relevé, Aerial, Ocular, transect

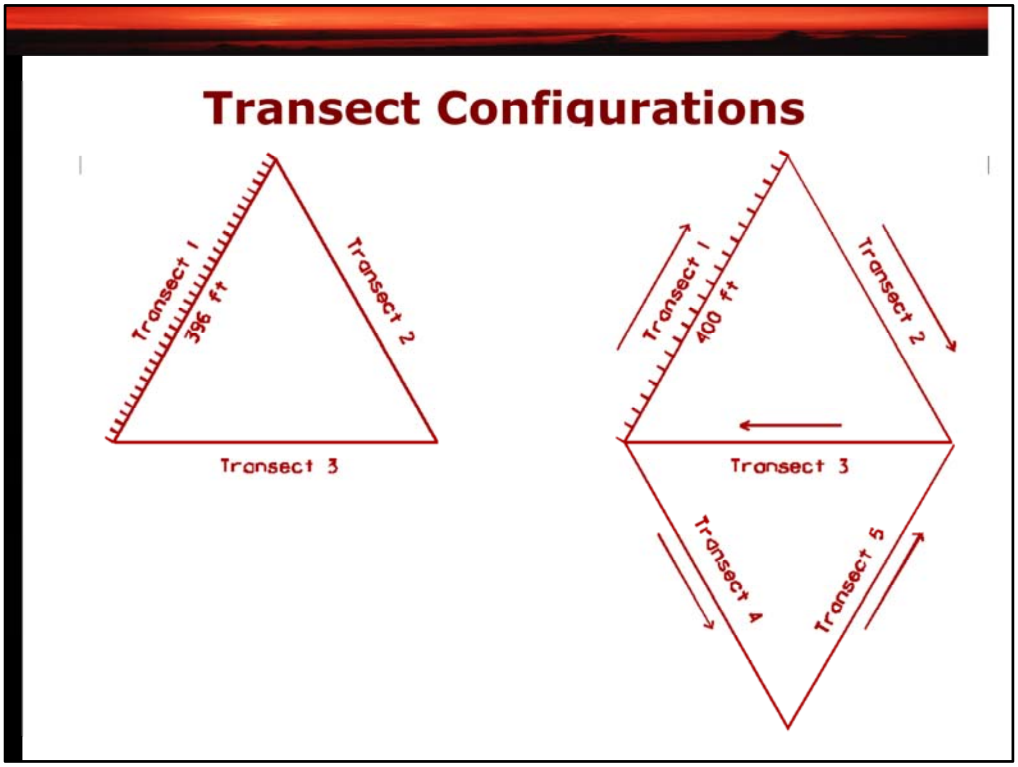
We often use multiple types in the same project – for example for the Tonsina projects we used NPS FirePro, WRST aerial, GRS Transect and ocular, and BLM Transect data.



My preferred method is the Line-point Transect … it was recently recommended by the Food and Agricultural Organization of the UN as the "most scientifically accurate, easiest-to-use, and most cost effective" data collection method of the four they evaluated.



Example diagram …

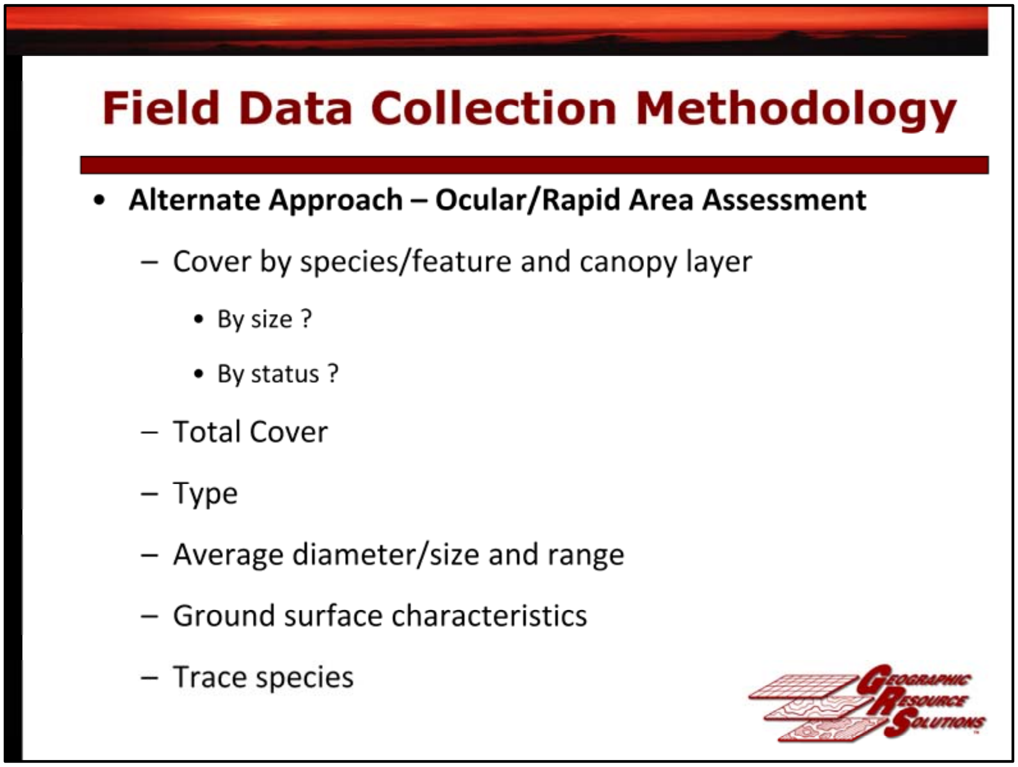


Typical configurations – designed to fit sample area.

We will use a linear transect for narrow riparian areas.

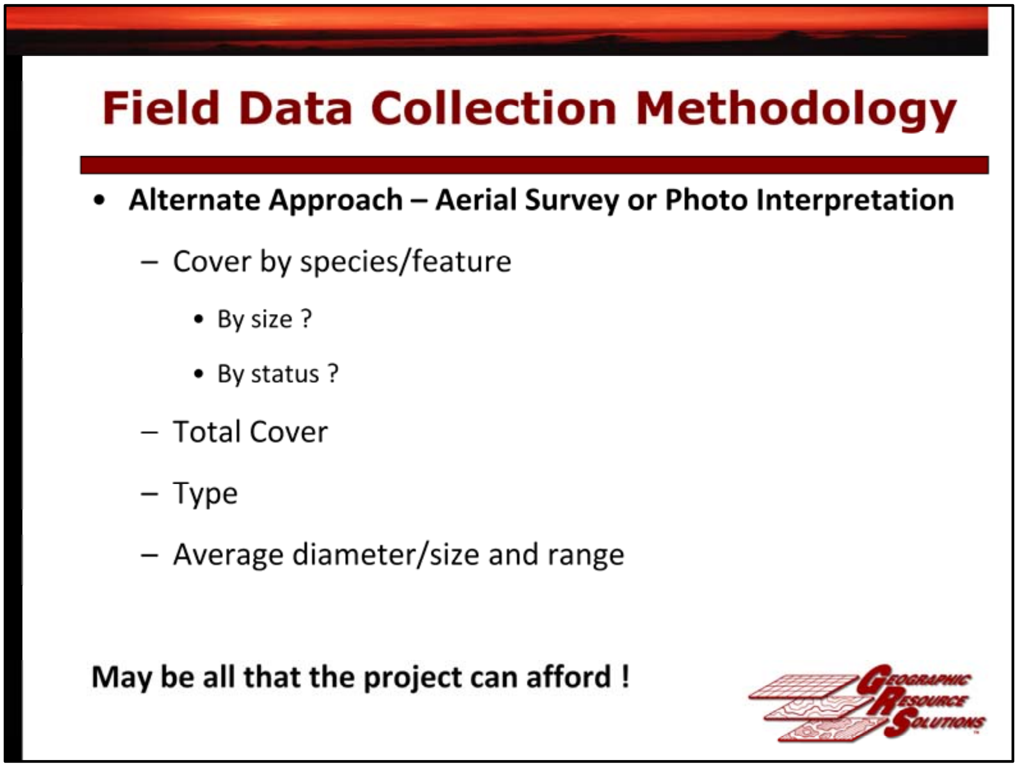
We will also use a square or rectangle.

Like the closed loop as it samples all aspects of the contour of the field site going both across and with the contours if there is slope.



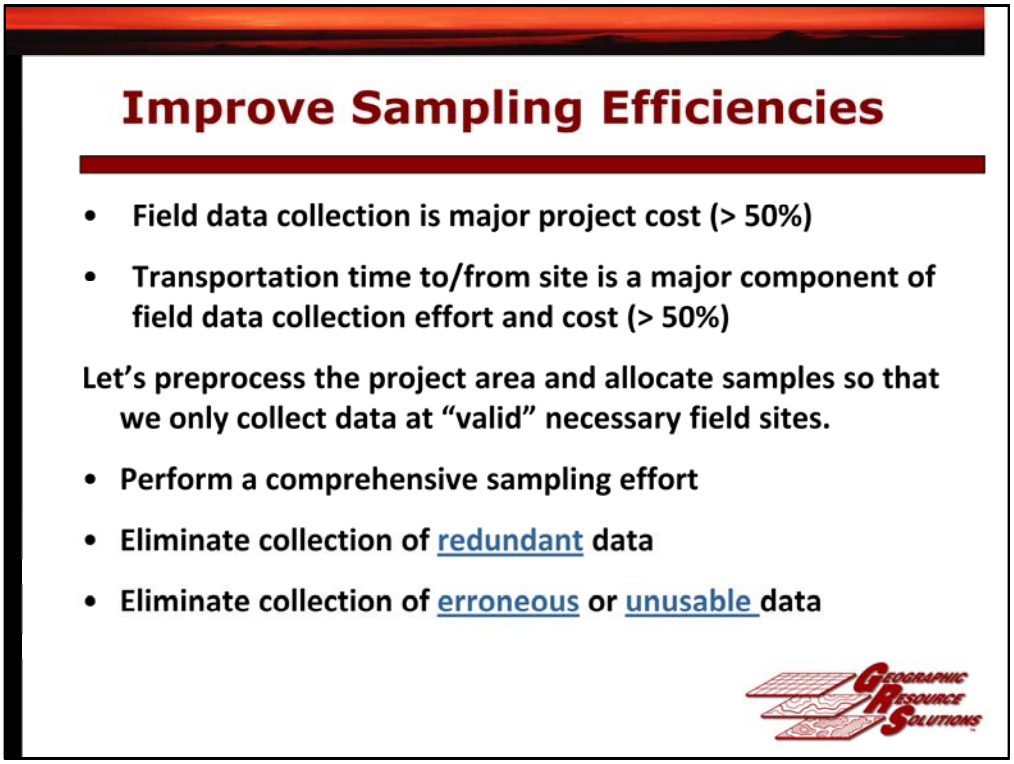
Alternate methodologies – ocular or rapid area assessment – these are the main techniques we have used in most of our AK projects.

However, when you use these techniques there is no way that someone will be able to accurately describe the different species-specific cover components by layer, so my preferred method is the line-point transect.



We will use this technique if it is the only means available.

I have never participated in a project yet where the ecologists didn't always want to collect more data and there was always too little funding available for them to do so!



Another key Field Data Collection element concerns the field sample design and improvement of field data collection efficiencies.

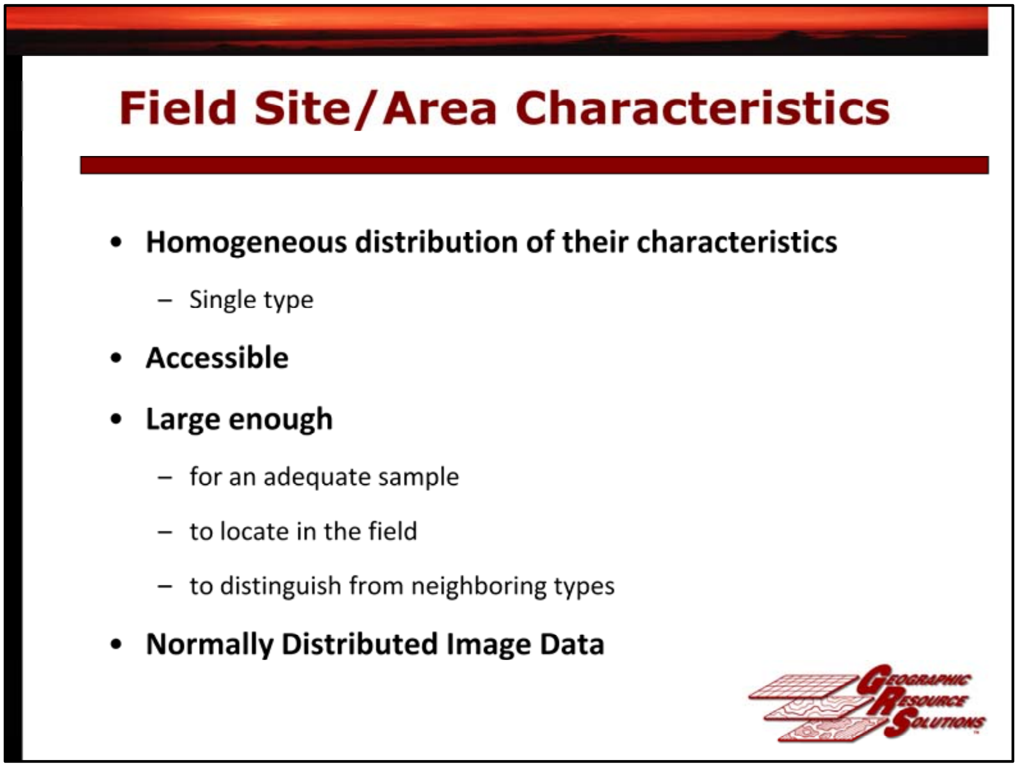
If funds are limited (which they nearly always are) then we must be able to collect as much of the "best" data as possible with the limited resources we have.

See slide …

Emphasize:

Eliminate collection of redundant data

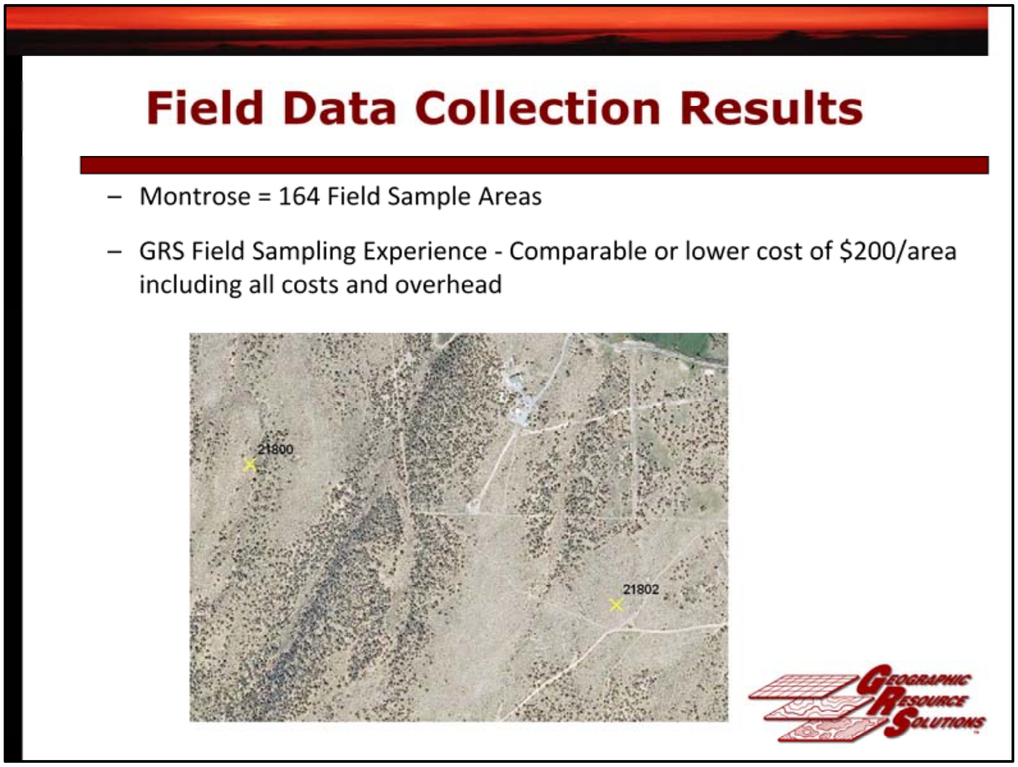
Eliminate collection of erroneous or unusable data



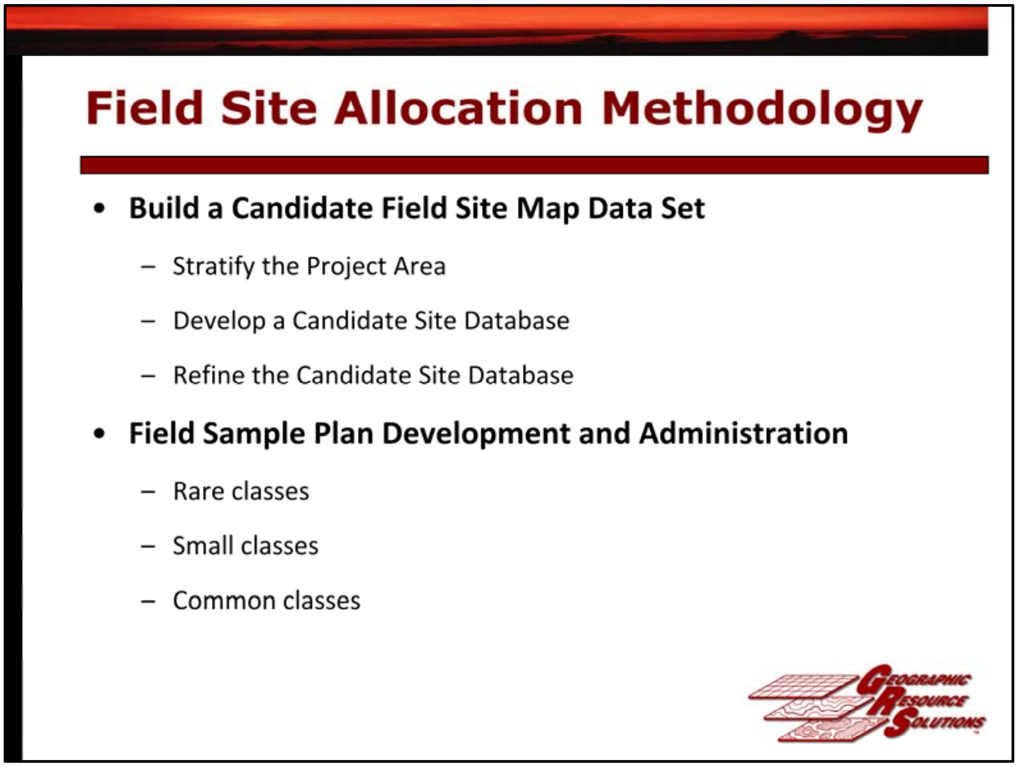
We look for areas that meet these requirements…

One of our RNSP botanists … “why did you make us hike two miles to sample an area when that type was also by the parking lot ?”

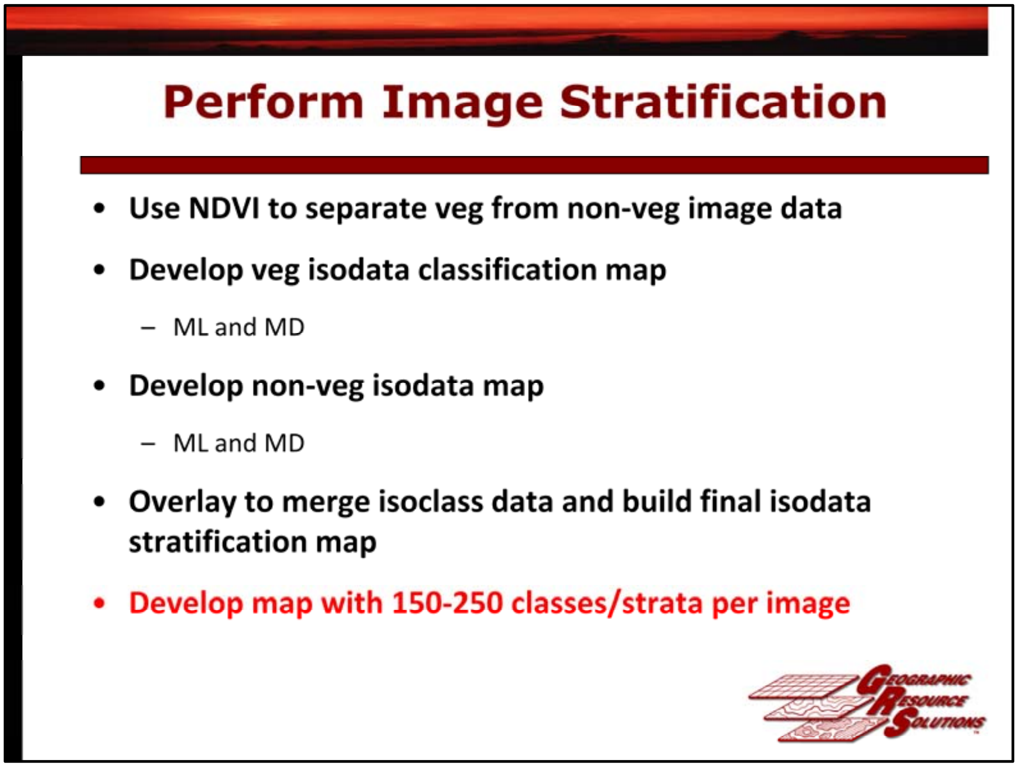
Because the close site was not large enough to provide a suitable spectral sample. Areas are picked to serve multiple purposes, not just for the vegetation classification.



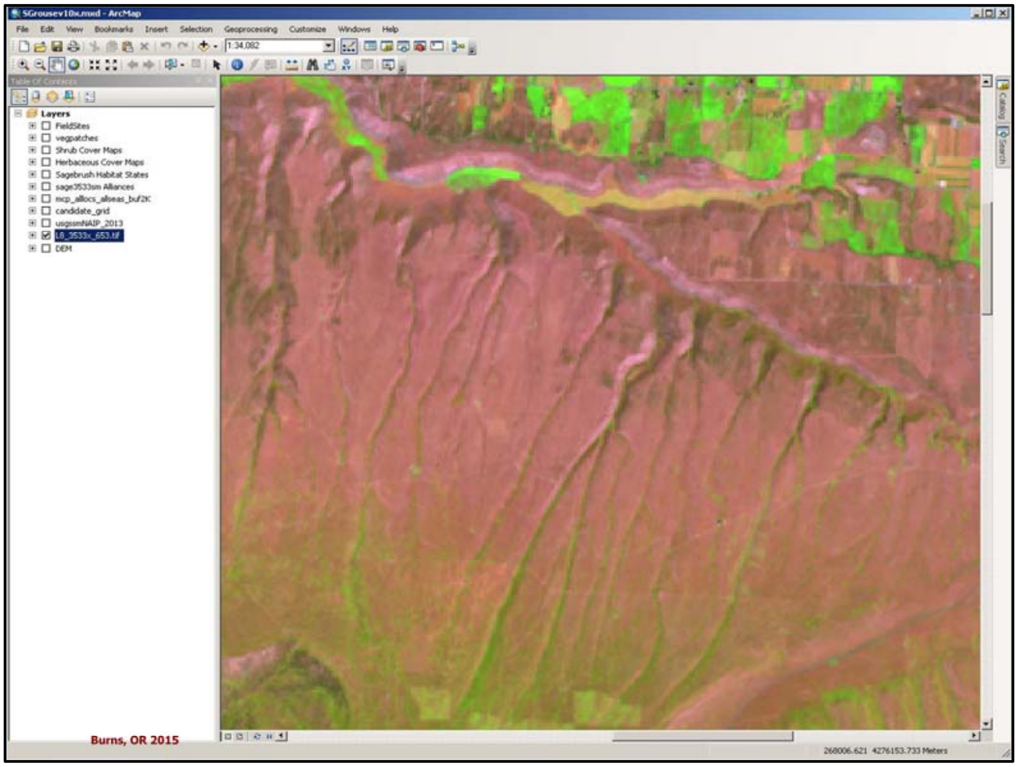
For each of these projects we collected data at over 400 “ground truth” sites at an average total (fully loaded) cost of about $200/site.


Field Site Allocation Methodology
• Build a Candidate Field Site Map Data Set
– Stratify the Project Area
– Develop a Candidate Site Database
– Refine the Candidate Site Database
• Field Sample Plan Development and Administration
– Rare classes
– Small classes
– Common classes
Geographic Resource Solutions

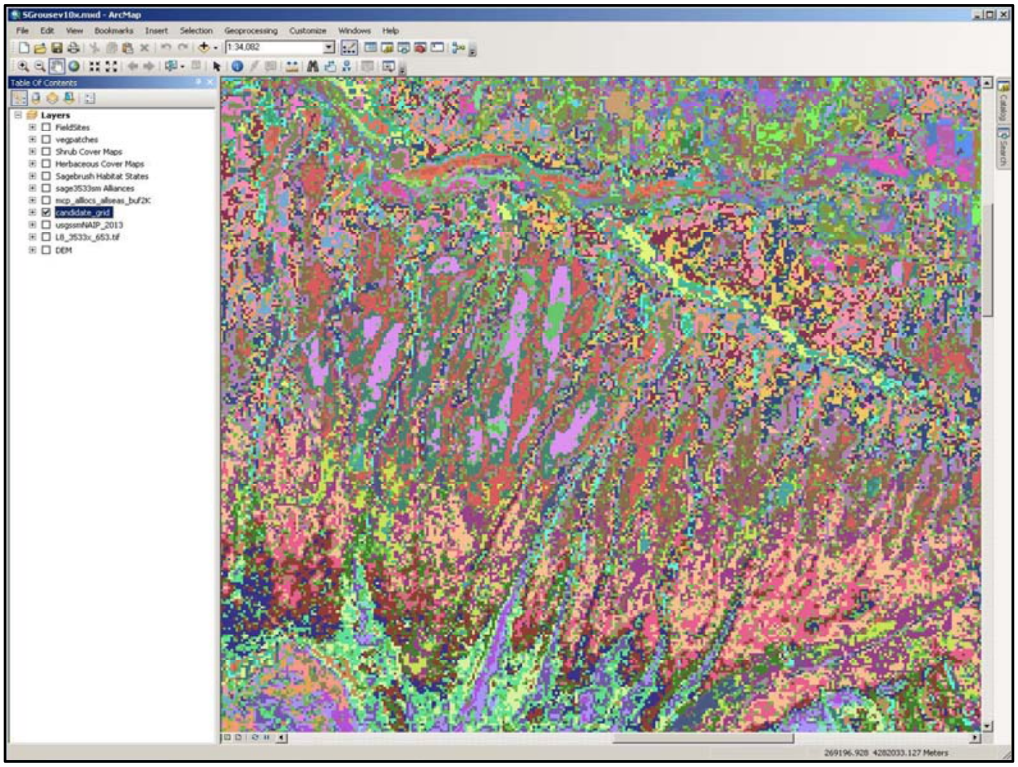
Based on …



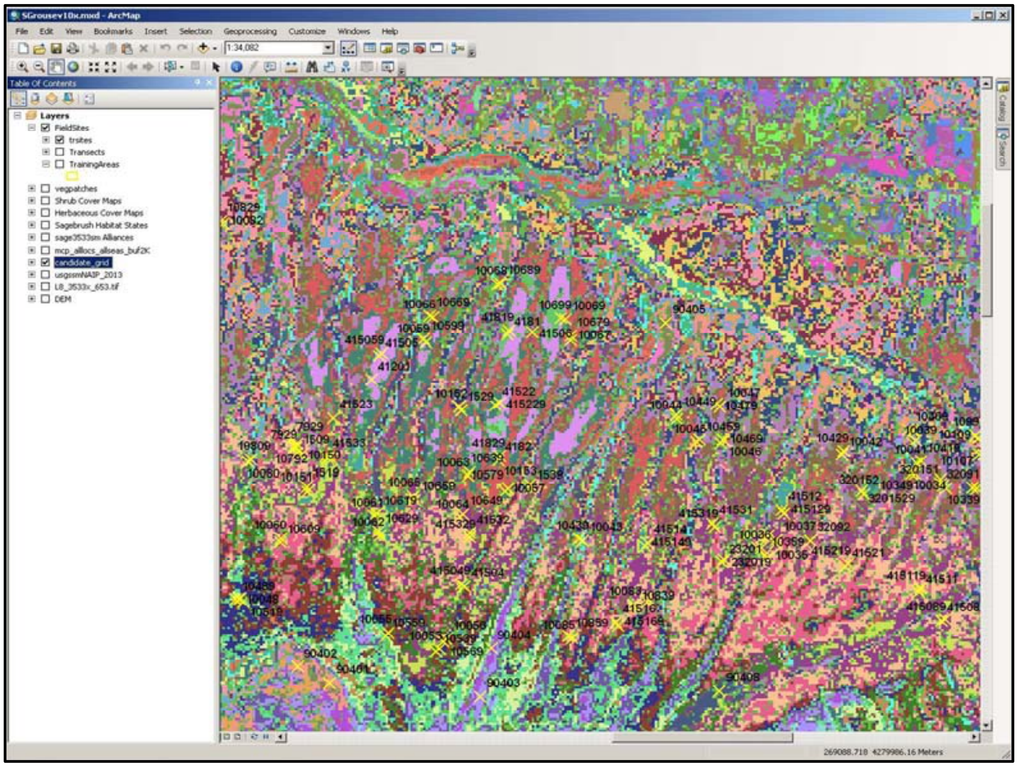
Highlight processes on slide …



Landsat imagery for the project is classified to develop a stratified data set …



Note the homogeneous areas ideal for field sampling.



Field Sites already selected ….

These field sites were not selected using our image stratification and therefore, a high percentage (~45%) of them were located on areas that lie

In a mixed area or along an ecotone.

Histogram d:\mgeprojects\usgssm\grd\3533strata.grd

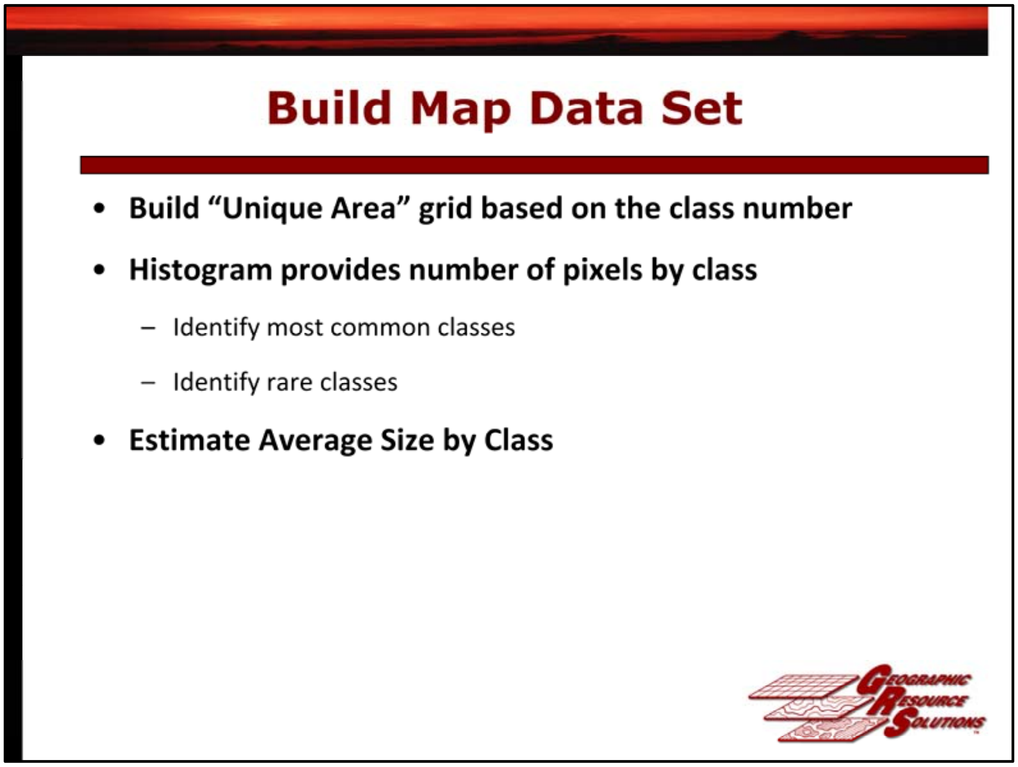
Value	Frequency	%	Cum. %	# Pure Samples	# Mixed Samples	Value	Frequency	%	Cum. %	# Pure Samples	# Mixed Samples
VOID	303679	63.14	63.14			41	946	0.20	92.43		
1	1158	0.24	63.38			42	2680	0.56	92.98		
2	5081	1.06	64.44	4	2	43	1088	0.23	93.21		
3	4296	0.89	65.33			44	902	0.19	93.40		
4	3595	0.75	66.08			45	1197	0.25	93.65		
5	5786	1.20	67.28	10	6	46	1678	0.35	94.00		
6	4442	0.92	68.21			47	1186	0.25	94.24		
7	2304	0.48	68.69	-	3	48	546	0.11	94.36		
8	2414	0.50	69.19	5	1	49	2360	0.49	94.85	-	1
9	6301	1.31	70.50	6	3	50	547	0.11	94.96		
10	6031	1.25	71.75	-	1	51	1601	0.33	95.29	1	1
11	1412	0.29	72.05			52	111	0.02	95.32		
12	4144	0.86	72.91	4	2	53	2550	0.53	95.85	-	1
13	2673	0.56	73.46			54	631	0.13	95.98		
14	221	0.05	73.51			55	1763	0.37	96.34	2	2
15	2397	0.50	74.01	5	4	56	494	0.10	96.45		
16	1242	0.26	74.27			57	1313	0.27	96.72		
17	5337	1.11	75.38	9	6	58	600	0.12	96.84	-	1
18	7202	1.50	76.87	2	1	59	1395	0.29	97.13		
19	3066	0.64	77.51			60	671	0.14	97.27		
20	6676	1.39	78.90	7	2	61	581	0.12	97.39		
21	6132	1.28	80.17	-	2	62	1221	0.25	97.65		
22	5797	1.21	81.38	-	2	63	1328	0.28	97.92		
23	2961	0.62	82.00			64	267	0.06	97.98	1	-
24	5773	1.20	83.20	1	5	65	207	0.04	98.02		
25	2939	0.61	83.81	1	3	66	615	0.13	98.15		
26	6116	1.27	85.08	1	2	67	263	0.05	98.21		
27	1396	0.29	85.37			68	323	0.07	98.27		
28	5723	1.19	86.56	4	-	69	953	0.20	98.47		
29	1257	0.26	86.82	-	1	70	892	0.19	98.66		
30	3410	0.71	87.53	1		71	620	0.13	98.79		
31	5410	1.12	88.65	3	4	72	351	0.07	98.86		
32	5862	1.22	89.87	2	2	73	642	0.13	98.99		
33	728	0.15	90.02			74	59	0.01	99.00		
34	3043	0.63	90.66	-	1	75	40	0.01	99.01		
35	933	0.19	90.85			76	150	0.03	99.04		
36	1957	0.41	91.26			77	103	0.02	99.07		
37	1291	0.27	91.53			78	277	0.06	99.12		
38	1130	0.23	91.76			79	187	0.04	99.16		
39	1211	0.25	92.01			80	127	0.03	99.19		
40	1044	0.22	92.23	5	1	Totals				74	60

Pure samples are ideal for relating the field data to the imagery.

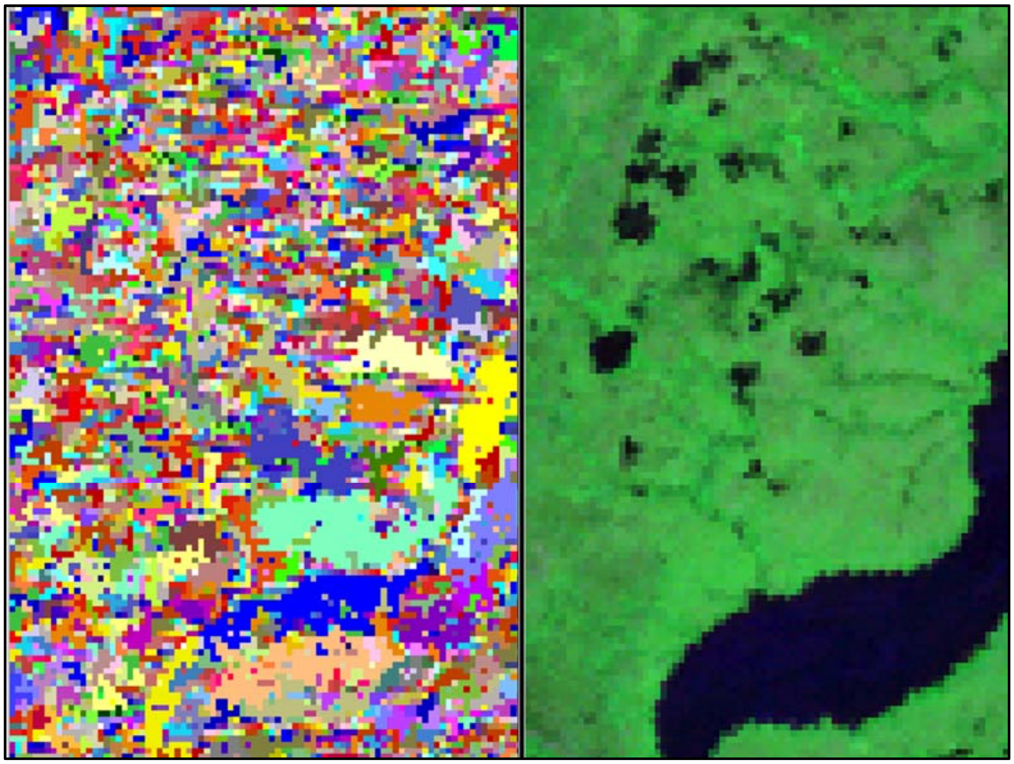
74/134 were in pure areas while the other 60 were on mixed areas.

Not all vegetation classes were sampled and some (most frequent by area) were sampled more than they likely needed to be (redundantly sampled class)

While other classes were likely undersampled.



Highlight processes on slide

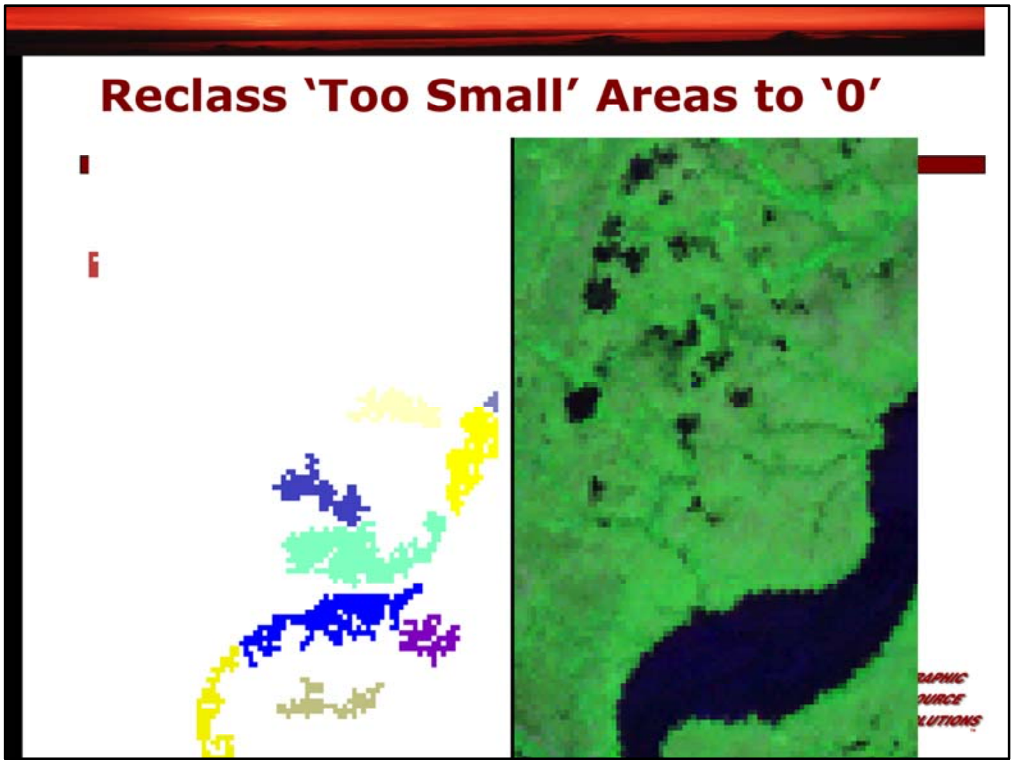


From Katmai NP Project - heterogeneous mix of classes for the basis of the stratification while imagery looks somewhat uniformly GREEN and BLUE

Candidate Sample Site Selection

- **Identify largest contiguous areas of each class by setting a minimum size threshold for sample areas**
- **Determine missing or rare classes**
  - Those having less than 5 sample areas
- **Add additional candidate areas to supplement scarce or missing classes by lowering the minimum size limit until a sufficient number of the largest size areas of each class have been identified**

This enables me to …



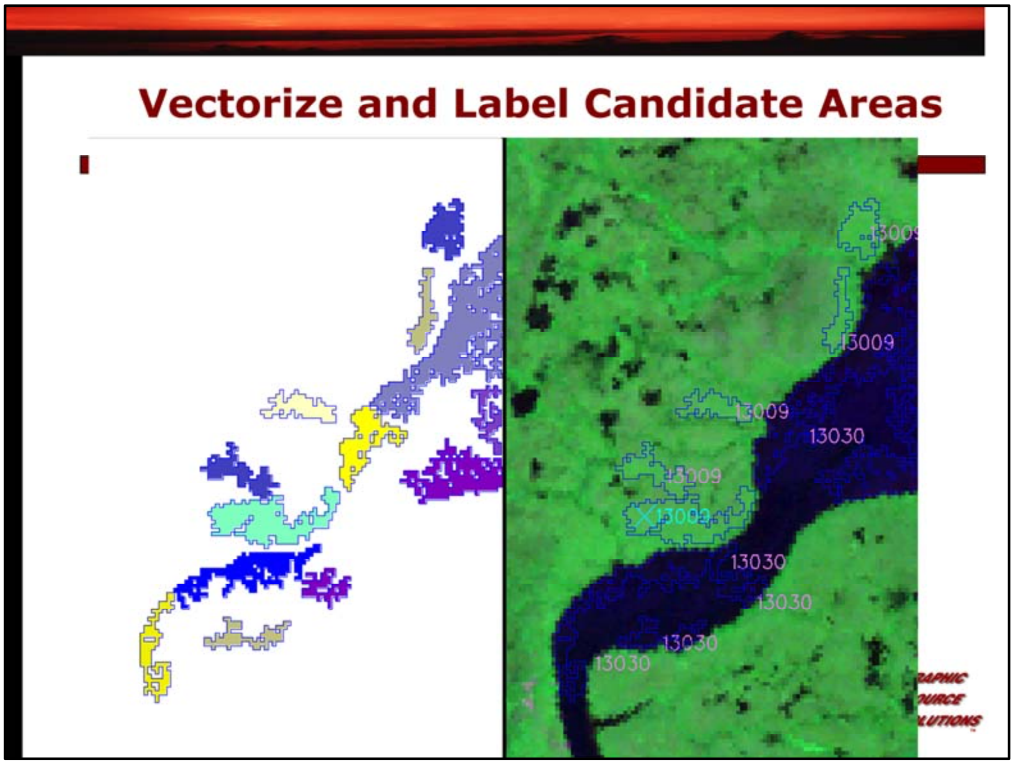
Filter out areas too small to sample leaving only the larger homogeneous areas

Characterize Candidate Sites - Frequency(Count) by Class

iso_class	freq	pixels	ave_size
13001	56	5699	101
13002	2	8497	4248
13003	175	22232	127
13004	96	10802	112
13005	44	4262	96
13006	64	6561	102
13007	428	73239	171
13008	87	17090	196
13009	393	77351	196
13010	278	37048	133
13011	90	9730	108
13012	25	60551	2422
13013	176	27261	154
13014	130	16639	127
13015	10	192441	19244
13016	104	18261	175
13017	138	19150	138
13018	20	1809	90
13019	56	6002	107
13020	148	24548	165

We can develop a summary of pixels/area by class which indicates numbers (freq) and average size.

Use this to identify rare classes or classes of small average size.

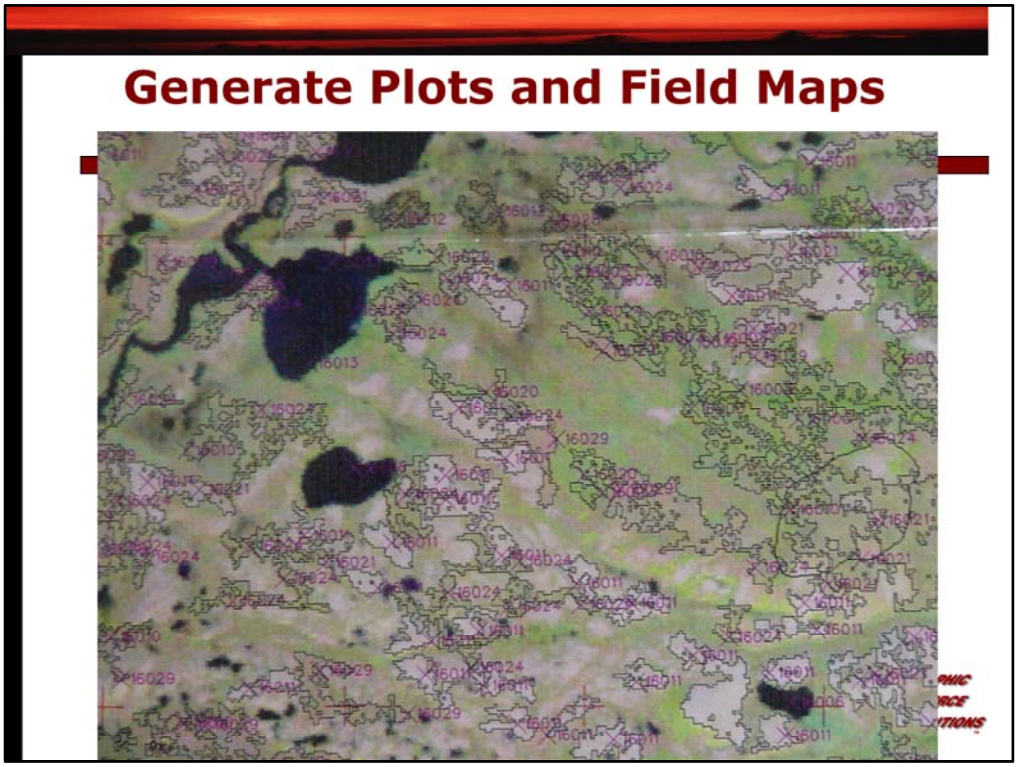


We then Vectorize the grid and Label the filtered candidate areas with their Class #

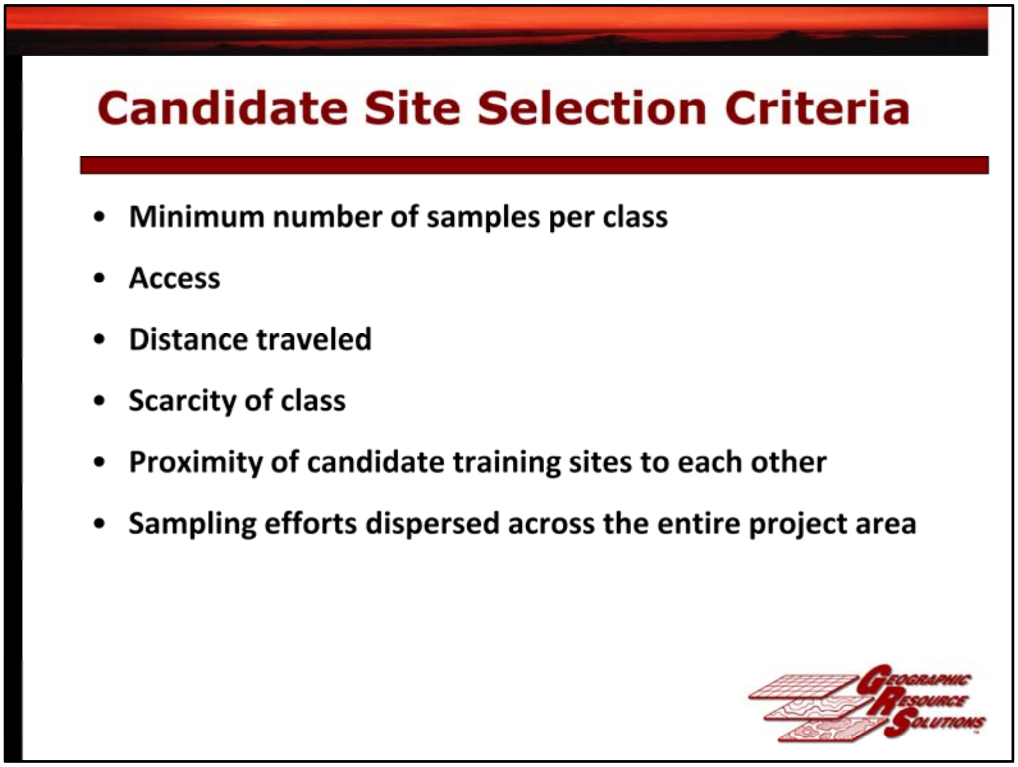
The Candidate Training Site Database Contains ...

- Land cover class value
- X,Y coordinates
- Area - number of pixels
- Slope, aspect, and elevation
- Scarcity flag
- Small size flag

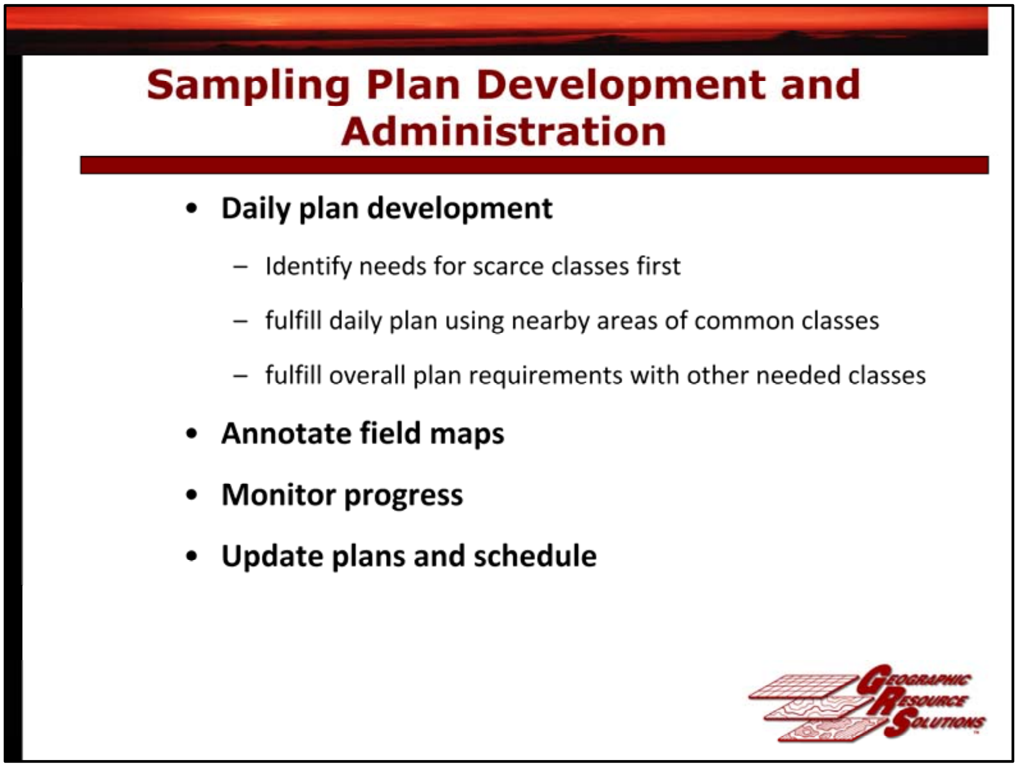
We populate specific area attributes for each candidate area.



We can then create and plot field maps … useful for planning purposes and for selecting other alternate nearby areas, if sampling plans cannot be followed.



I consider these attributes when selecting candidate areas and …



… building daily and weekly sampling plans.

We can then use all of these plans to monitor our progress, track our results, and modify our schedule, if necessary

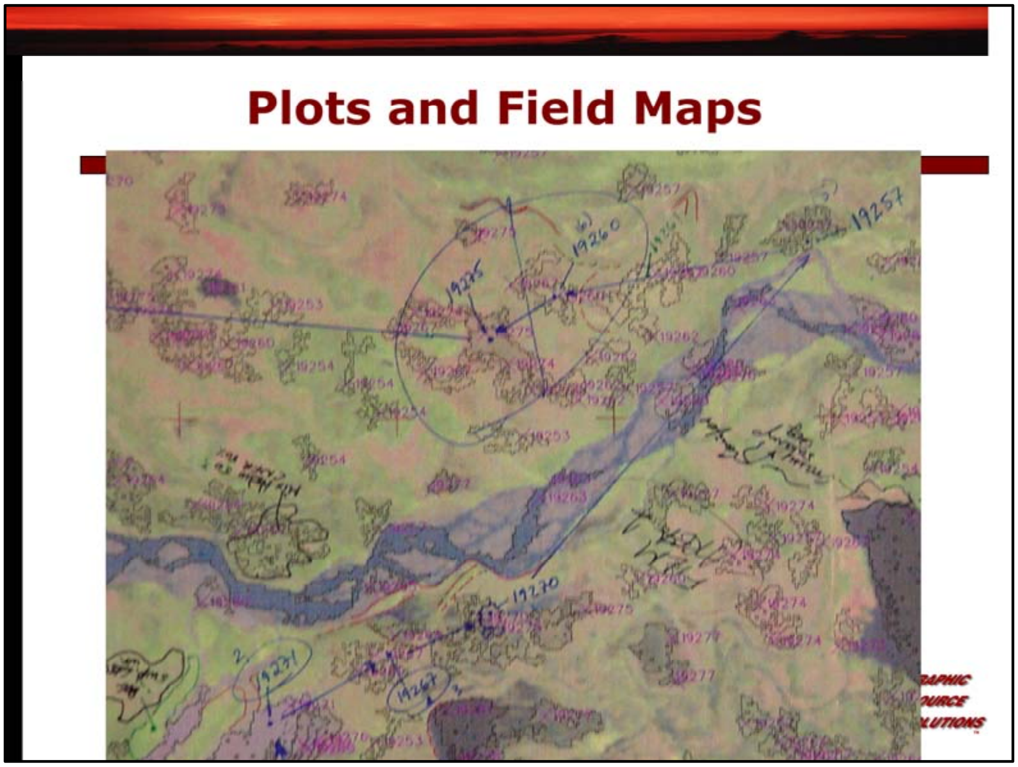
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Date:	13-Oct-08									By:	KS			
2	tr_group	aasite_id	aa_id#1	aa_id#2	lat	lat_min	long	long_min	aspect	slope	elev_ft	map	TRStart	TRInt	TRAz(s)
25	1064	AA3650			40	26:44.0	-121	33:47.9	209	67	8961	0	SW	6	T-0
26	1064	AA2770			40	26:43.3	-121	33:48.5	212	67	8879	0	SE	9	T-300-60-180
27	1064	AA508			40	26:30.1	-121	33:56.9	183	38	8246	0	SE	9	T-300-60-180
28	1064	AA1037			40	26:07.4	-121	33:28.0	142	31	8066	0	SW	9	T-0
29	1064	AA12590			40	26:02.4	-121	34:14.5	236	27	7636	0	E	6	T-240-360-120
30	**1064**	**AA202**			**40**	**25:29.9**	**-121**	**33:42.3**	**208**	**9**	**7429**	**0**	**W|E**	**12**	**T-60|T-240**
31	1065	AA353			40	30:43.4	-121	28:33.8	85	38	6832	0	NW	6	T-120-240-360
32	1065	AA4189			40	30:39.2	-121	28:32.0	83	40	6783	0	SE	6	T-300-60-180
33	1065	AA134			40	30:40.6	-121	28:24.9	336	18	6616	0	SW	9	T-0
34	1065	AA1282			40	30:49.2	-121	28:02.0	21	7	6478	0	sw	12	T-0
35	1065	AA978			40	30:49.2	-121	28:00.0	48	9	6472	0	sw	12	T-0
36	1065	AA17868			40	30:51.4	-121	27:50.3	165	22	6393	0	W	6	L-50@90
37	1065	AA3274			40	30:50.3	-121	27:36.4	167	22	6353	0	SE	6	L-50@330
38	1065	AA1900			40	30:54.9	-121	27:43.2	111	7	6452	0	SW	12	T-0
39	1071	AA18354			40	32:28.3	-121	31:15.0	210	58	7092	0	SW	12	T-0
40	1071	AA11662			40	32:29.0	-121	31:10.4	185	67	7183	0	NW	12	T-120
41	1071	AA11345			40	32:32.4	-121	31:16.9	239	47	7160	0	NE	6	T-180
42	1071	AA3183			40	32:36.2	-121	31:19.0	265	36	7167	0	SW	12	T-0
43	1071	AA14706			40	32:37.6	-121	31:10.3	26	36	7223	0	SE	12	L-25@285-25@355
44	1071	AA3699			40	32:40.7	-121	31:18.2	304	22	7174	0	SW	12	T-0
45	1071	AA171			40	32:35.8	-121	32:00.6	297	24	6462	0	SW	12	T-0
46	1072	AA105			40	34:23.8	-121	20:46.4	309	33	8292	0	NW|SE	126	T-120-240-360|T-300(occ)
47	1072	AA218			40	34:37.2	-121	21:00.1	330	29	7866	0	W	12	T-60-180-300
48	1072	AA290			40	34:15.3	-121	21:04.9	13	16	7961	0	NW	12	T-120-240-360
49	1072	AA2000			40	34:02.4	-121	21:29.8	260	40	7587	0	W	6	T-60-180-300
50	1072	AA1695			40	33:37.7	-121	21:44.0	227	33	7078	0	E	6	T-240-360-120
51	1073	AA281			40	32:01.9	-121	16:52.4	292	16	6294	0	NE	12	T-180-300-60
52	1073	AA21			40	32:12.9	-121	17:15.1	38	11	6258	0	SW	12	T-0
53	1073	AA147			40	32:11.9	-121	17:18.3	326	9	6268	0	W|E	12	T-0|T-240-360-120
54	1073	AA137			40	32:24.7	-121	17:44.3	349	4	6183	0	SW	6	T-0
55	1073	AA3473			40	32:29.0	-121	17:42.0	292	4	6180	0	SW	6	T-0
56	1073	AA4864			40	32:35.6	-121	17:40.3	301	2	6176	0	W	6	T-60
57	1073	AA1354			40	32:37.0	-121	17:37.4	307	2	6180	0	W	6	T-60
58	1074	AA3914			40	28:47.9	-121	30:37.8	203	44	9043	0	0	0	OCCULAR?
59	1074	AA2033			40	29:02.1	-121	31:05.9	252	44	8617	0	NW	9	T-120-240-360

Sheet1 0702sched

We can then print the plans and schedules for the field crews and assign groups of sites to specific field crews.

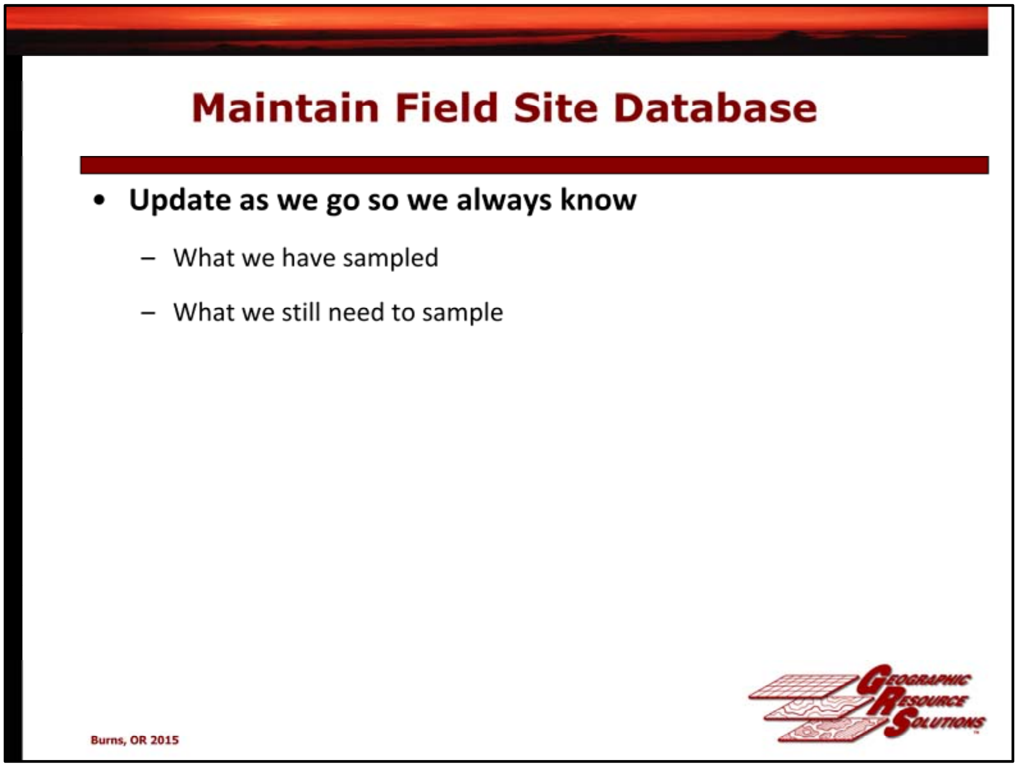
Plans now include all necessary info describing the layout of the transect – starting point, configuration, azimuths, and spacing.

We load the coordinate data and target_id values in this schedule right into GPS units



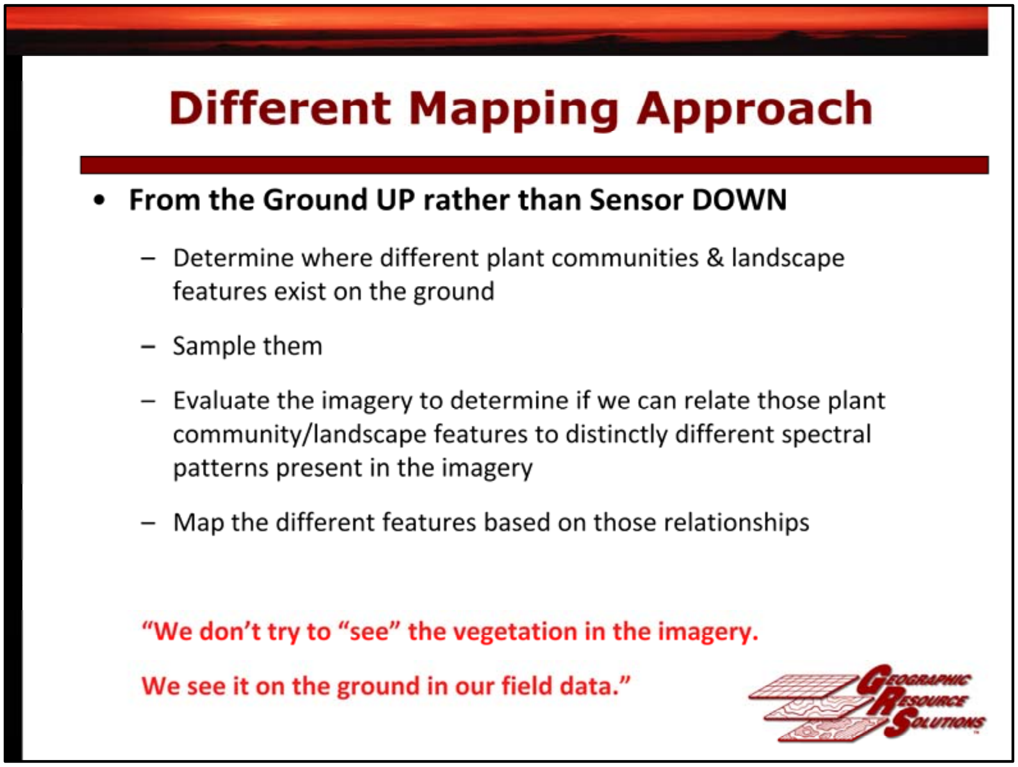
Field maps are annotated by field crews to show sampling plan.

Field crew can add their own notes as they visit sites and implement the plan.



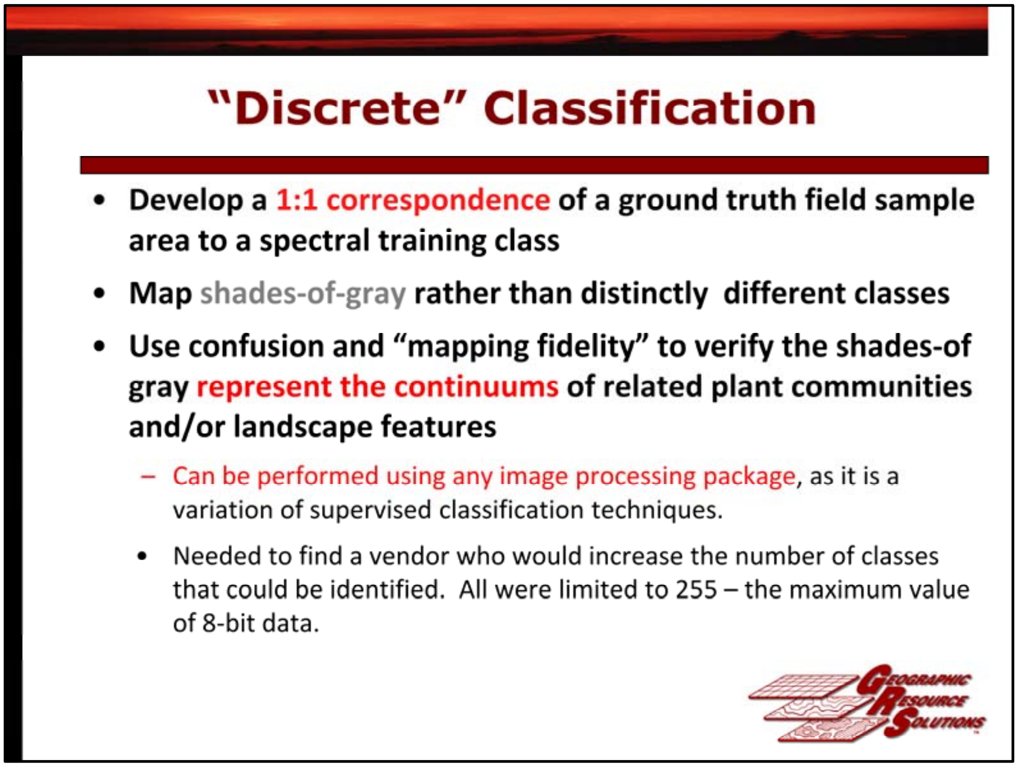
…

Now on to the next key element of our methodology – Discrete Classification



See slide … emphasize "Ground up" rather than "Sensor down"

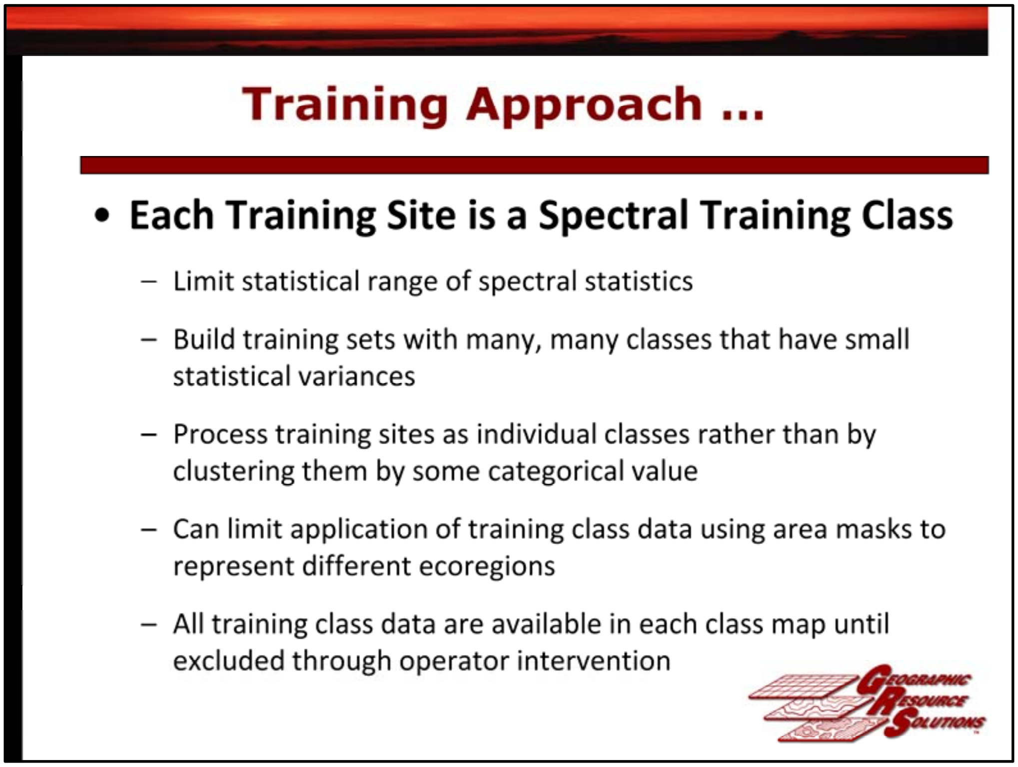
This is a critical concept/difference between how we develop the map data sets and how others do this. We don't try to "See" the features in the imagery.



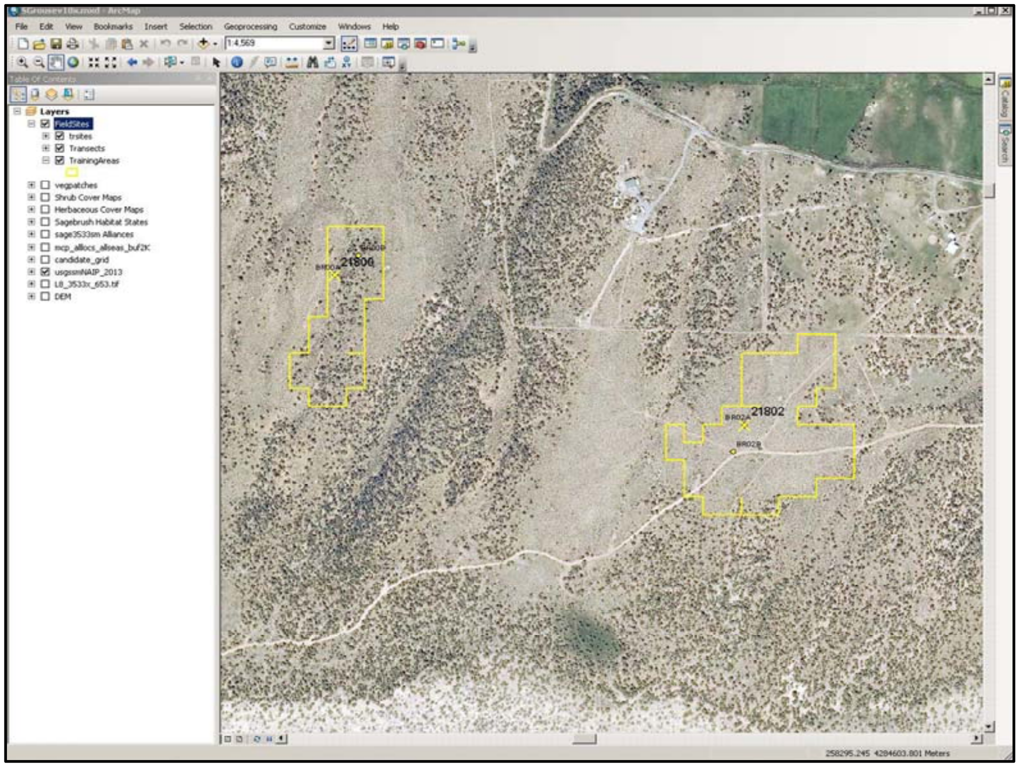
We then developed a classification method we call "Discrete Classification."

It involves a 1:1 correspondence between our training areas and our spectral classes.

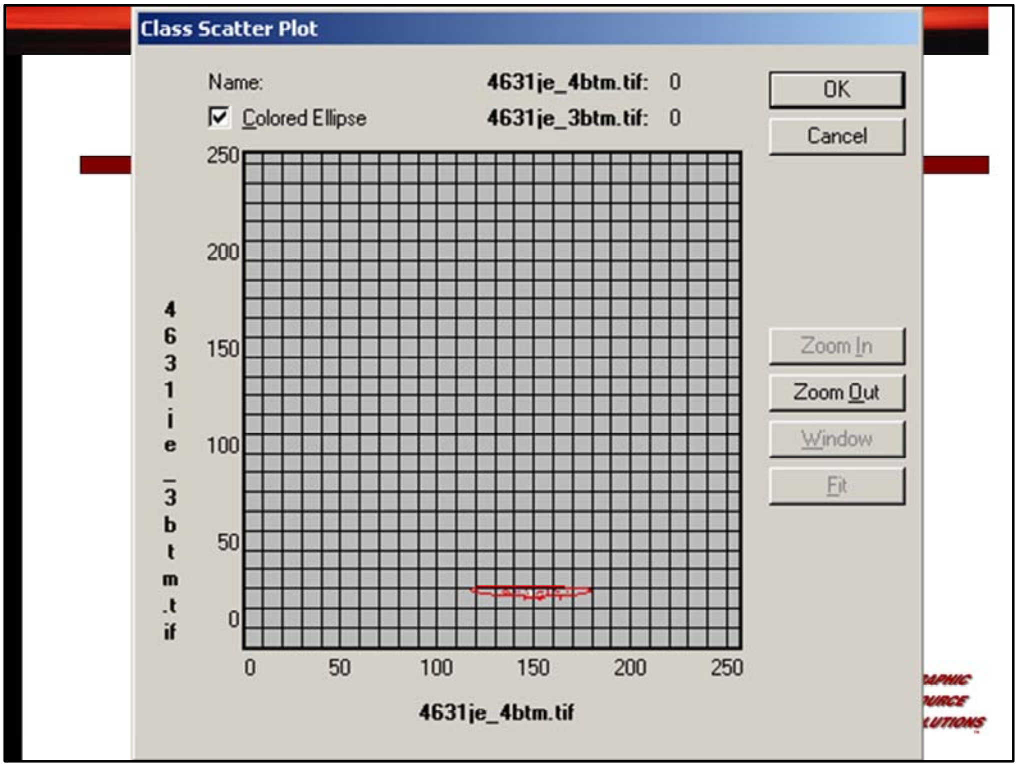
This approach maps many shades-of-gray that represent the multi-dimensional continuum of landscape and plant community features found within each project area.



Review slide …



Example from USGSSM project of two field sites and their spectral training area polygons.



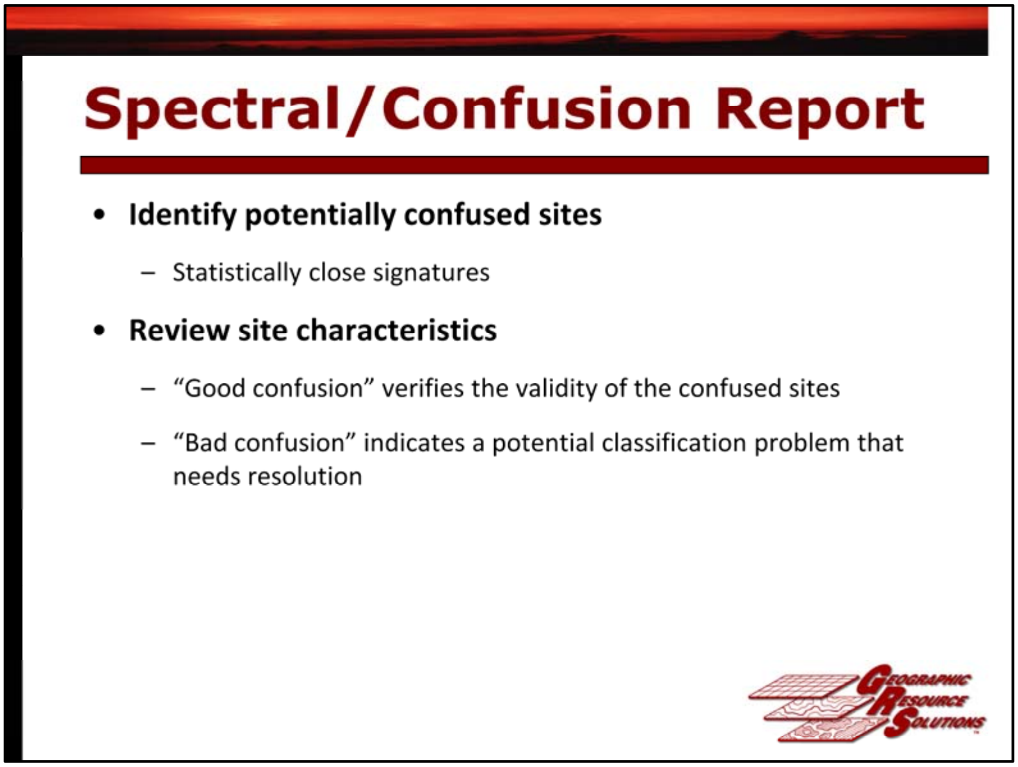
We review the spectral data collected for every field site – and verify that we have generated spectral signatures with small variances

How do we know we have created good relationships between the field sites and the imagery?

Training Site Evaluation - Are These Good Relationships?

- **Spectral/Confusion Report**
  - Good versus bad confusion
- **Fidelity Report**
  - Training areas classify correctly

We have two ways to verify we are mapping shades-of-gray and eliminating confused training classes



First, we generate a Confusion Report – in which we can identify "GOOD" and "BAD" confusion.

We will need to resolve the sites that indicate "Bad confusion."

Spectral/Confusion Analysis

Training Set	Confused trsite_id	J-M Dist	Iso Class	Cover Type	Calculated Class	Tree Cover	Shr Cover	LShr Cover	Herb Cover	Bar. Cover	cv_arno4	cv_artrt	cv_artrv	cv_artrw8	cv_amut	cv_quga	cv_chde2	cv_brte	cv_graminoidP	cv_graminoidA	pct_per
Trsite_id:	10039		31	1147	An:shrub/HOXP-Km:herb	0	13	0	43	100	13	0	0	0	0	0	0	0	28	0	100
sage	10040	1.097	724	4400	HOGP-Km:herb	0	8	2	47	100	5	0	0	1	0	0	0	0	38	0	89
Trsite_id:	10043		725	2547	Au-An-Atv:shrub/HOXP-Pf:herb	0	25	0	45	94	5	0	4	0	14	2	0	0	31	0	98
sage	320151	1.425	31	2144	An-Au-Atv:shrub/HOGP-Pf:herb	0	22	1	42	99	6	0	4	0	4	4	1	0	32	0	82
Trsite_id:	10079		17	2247	Att-An:shrub/HOXP-Pf:herb	0	22	1	43	98	6	15	0	0	0	0	1	0	32	0	93
sage	10792	1.169	17	1247	Att:shrub/HOXP-Pf:herb	0	20	0	55	98	0	15	0	0	5	0	0	0	33	0	96
Trsite_id:	32092		5	1144	An:shrub/HOGP-Pf:herb	0	17	1	56	100	15	0	0	0	1	0	1	0	48	0	97
sage	41512	1.493	5	2150	An-Cd-Au:shrub/HOtP-Pf:herb	0	22	7	42	100	12	0	0	0	3	0	5	0	38	0	100

Confusion examples – we review similarity of vegetation characteristics of confused sites.

We use these related sites to verify we are recognizing shades-of-gray of slightly different different types –

or verify “We have a PROBLEM, as indicated by BAD confusion” between completely non-related different types.

Fidelity Evaluation

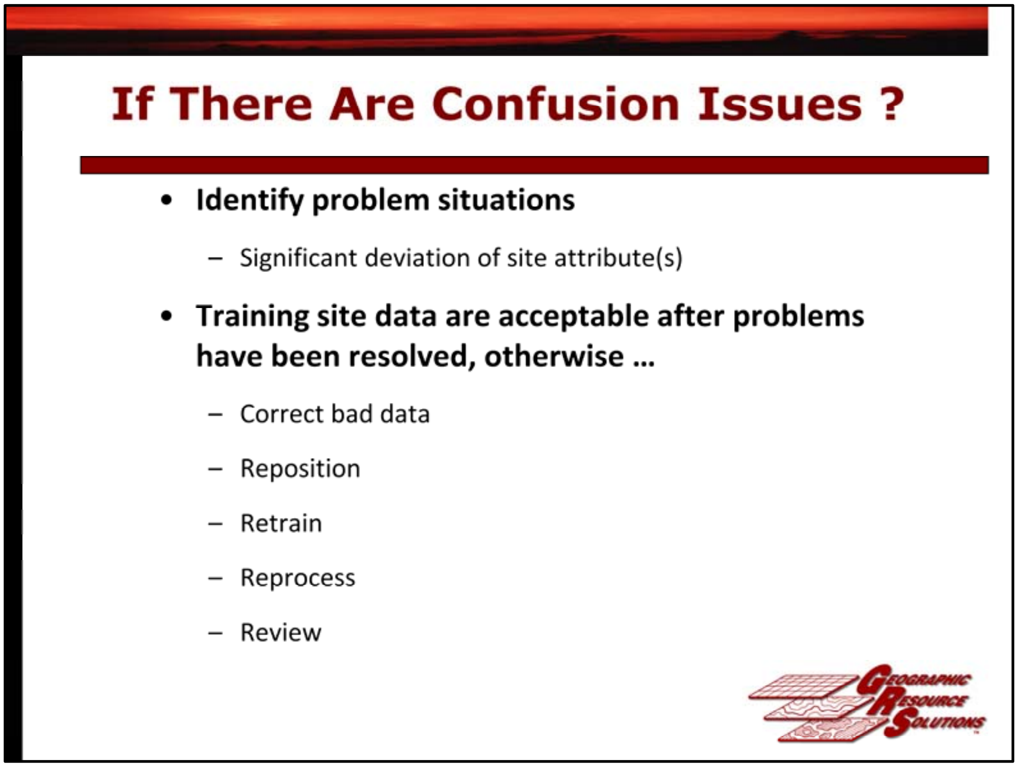
- **Perform self-classification of field training areas**
- **Do we get the same attribute values ?**
  - Compare vegetation/land cover characteristics to determine suitability of “match” between field data and classification estimates

We also review the classification results to determine how well a training areas is classified. We review the degree of “self-classification” of an area and the training area’s calculated (weighted average) attributes for the area compared with the actual field data values collected there. Are they the same or is it different? Significant differences indicate data migration away from field estimates due to infiltration of the training area by dissimilar classes. This infiltration of different classes is due to BAD confusion.

Fidelity Report

A	B	C	D	E	F	G	H	BJ	BK	BL	BM	BN	BO	BP	B
Trset	trsite_id	typeNuml	Type Match	Self Match	%Self	pixel count	calc_class	cv_ARNO4	cv_ARTRT	cv_ARTRV	cv_ARTRW	cv_AMUT	cv_CHDE	cv_MAFR	cv_Q
	10029														
Version1_ml	10030	2349	M	M	90%	45	Atv-Sr-Au:shrub/HOXX-Km:herb	0.8	0	17.5	0.1	3.3	0	0	
Sage_ml	10030	2349	M	m	74%	37	Atv-Sr-Au:shrub/HOXX-Km:herb	0.8	0	17.5	0.1	3.3	0	0	
Sage_md	10030	2349	m	N	24%	12	Atv-An-Au:shrub/HOXX-Km:herb	5.3	0.3	7.8	1.4	3.4	0.2	1.3	
TrainingCalc'd	10030	2349				1	Atv-Sr-Au:shrub/HOXX-Km:herb	0	0	21	0	3	0	0	
------	10030														
	10030														
Version1_ml	10031	2147	M	M	94%	29	An-Au-Atw:shrub/HOXP-Km:herb	6	0	0	3	3	0	0	
Sage_ml	10031	2147	M	M	94%	29	An-Au-Atw:shrub/HOXP-Km:herb	6	0	0	3	3	0	0	
Sage_md	10031	2147	M	M	84%	26	An-Au-Atw:shrub/HOXP-Km:herb	5	0	2.3	2.5	3.1	0	0.5	
TrainingCalc'd	10031	2147				1	An-Au-Atw:shrub/HOXP-Km:herb	6	0	0	3	3	0	0	
------	10031														
	10031														
Version1_ml	10032	2349	M	M	100%	9	Atv-Qg-Au:shrub/HOXX-Pp:herb	0	0	21	0	5	0	0	
Sage_ml	10032	2349	M	M	100%	9	Atv-Qg-Au:shrub/HOXX-Pp:herb	0	0	21	0	5	0	0	
Sage_md	10032	2349	M	m	67%	6	Atv-Qg-Au:shrub/HOXX-Pp:herb	0	0	14	0	3.3	0	0	
TrainingCalc'd	10032	2349				1	Atv-Qg-Au:shrub/HOXX-Pp:herb	0	0	21	0	5	0	0	
------	10032														
	10032														
Version1_ml	10033	2144	M	M	100%	20	An-Au-Atv:shrub/HOGP-Pf:herb	10.4	0.6	3.2	0	8.4	0.5	0	
Sage_ml	10033	2144	M	M	75%	15	An-Au-Atv:shrub/HOGP-Pf:herb	9.9	0.6	3.5	0	8.4	0.6	0	
Sage_md	10033	2144	M	N	20%	4	An-Au-Atv:shrub/HOGP-Pf:herb	7.1	1.6	4.8	0.2	6.1	1.5	0	
TrainingCalc'd	10033	2144				1	An-Au-Atv:shrub/HOGP-Pf:herb	11	0	3	0	10	0	0	

On a site by site basis we review and identify significant differences of characteristics where the weighted average values are deviating from the field estimated values. When data are migrating away from the ground truth values it is due to spectral confusion with sites that have different characteristics.



We resolve these issues as best we can …

See slide …

Sometimes we find problems in the field data collection efforts.

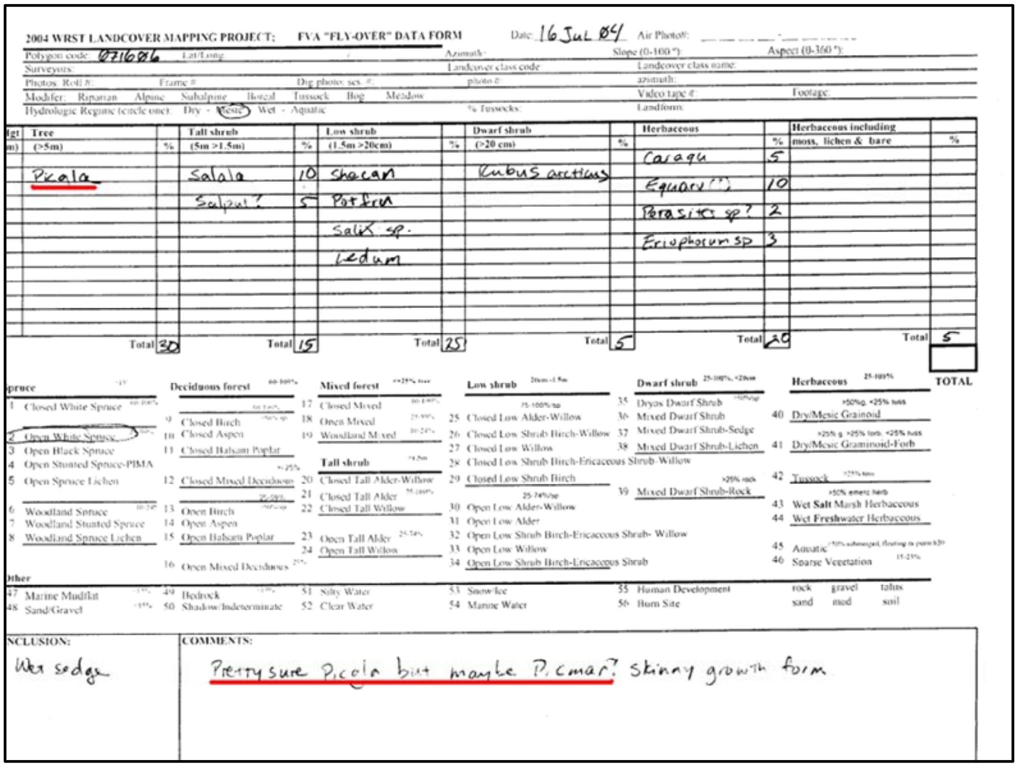
WRST example – consider site 71606 which was originally called a White Spruce site …

This Woodland White Spruce type was confused with several Black Spruce types

In the Fidelity Report cover values migrated from PicGla to PicMar cover

What the heck ? We tried all sorts of retraining approaches but none resolved this confusion.

Finally went back and looked at data sheet!



2004 WRST LANDCOVER MAPPING PROJECT: FVA "FLY-OVER" DATA FORM Date: 16 Jul 04 Air Photo#:

Polygon code: 071606 Lat/Long: Azimuth: Slope (0-100°): Aspect (0-360°):

Surveyors: Landcover class code: Landcover class name:

Photos: Roll #: Frame #: Dig photo: ses. #: photo #: azimuth:

Modifer: Riparian Alpine Subalpine Boreal Tussock Bog Meadow Video tape #: Footage:

Hydrologic Regime (circle one): Dry - Mesic - Wet - Aquatic % Tussocks: Landform:

Tree (>5m)	%	Tall shrub (5m >1.5m)	%	Low shrub (1.5m >20cm)	%	Dwarf shrub (>20 cm)	%	Herbaceous	%	Herbaceous including moss, lichen & bare	%
								Caraqu	5		
Picgla		Salala	10	Shecan		Rubus arcticus		Equarv (?)	10		
		Salpul?	5	Potfru				Petasites sp?	2		
				Salix sp.				Eriophorum sp	3		
				Ledum							
Total	30	Total	15	Total	25	Total	5	Total	20	Total	5

TOTAL

Spruce: 1 Closed White Spruce; 2 Open White Spruce; 3 Open Black Spruce; 4 Open Stunted Spruce-PIMA; 5 Open Spruce Lichen; 6 Woodland Spruce; 7 Woodland Stunted Spruce; 8 Woodland Spruce Lichen

Deciduous forest: 9 Closed Birch; 10 Closed Aspen; 11 Closed Balsam Poplar; 12 Closed Mixed Deciduous; 13 Open Birch; 14 Open Aspen; 15 Open Balsam Poplar; 16 Open Mixed Deciduous

Mixed forest: 17 Closed Mixed; 18 Open Mixed; 19 Woodland Mixed

Tall shrub: 20 Closed Tall Alder-Willow; 21 Closed Tall Alder; 22 Closed Tall Willow; 23 Open Tall Alder; 24 Open Tall Willow

Low shrub: 25 Closed Low Alder-Willow; 26 Closed Low Shrub Birch-Willow; 27 Closed Low Willow; 28 Closed Low Shrub Birch-Ericaceous Shrub-Willow; 29 Closed Low Shrub Birch; 30 Open Low Alder-Willow; 31 Open Low Alder; 32 Open Low Shrub Birch-Ericaceous Shrub- Willow; 33 Open Low Willow; 34 Open Low Shrub Birch-Ericaceous Shrub

Dwarf shrub: 35 Dryas Dwarf Shrub; 36 Mixed Dwarf Shrub; 37 Mixed Dwarf Shrub-Sedge; 38 Mixed Dwarf Shrub-Lichen; 39 Mixed Dwarf Shrub-Rock

Herbaceous: 40 Dry/Mesic Graminoid; 41 Dry/Mesic Graminoid-Forb; 42 Tussock; 43 Wet Salt Marsh Herbaceous; 44 Wet Freshwater Herbaceous; 45 Aquatic; 46 Sparse Vegetation

Other: 47 Marine Mudflat; 48 Sand/Gravel; 49 Bedrock; 50 Shadow/Indeterminate; 51 Silty Water; 52 Clear Water; 53 Snow/Ice; 54 Marine Water; 55 Human Development; 56 Burn Site; rock gravel talus sand mud soil

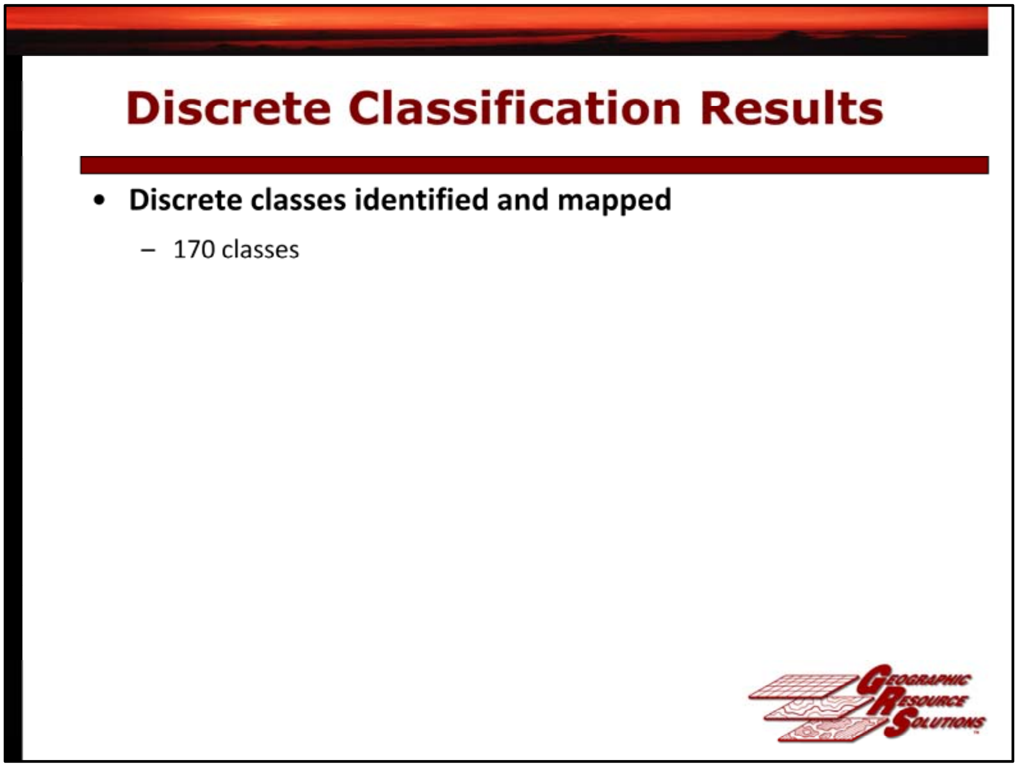
INCLUSION: Wet sedge

COMMENTS: Pretty sure Picgla but maybe P. cmar? skinny growth form

Low and behold !

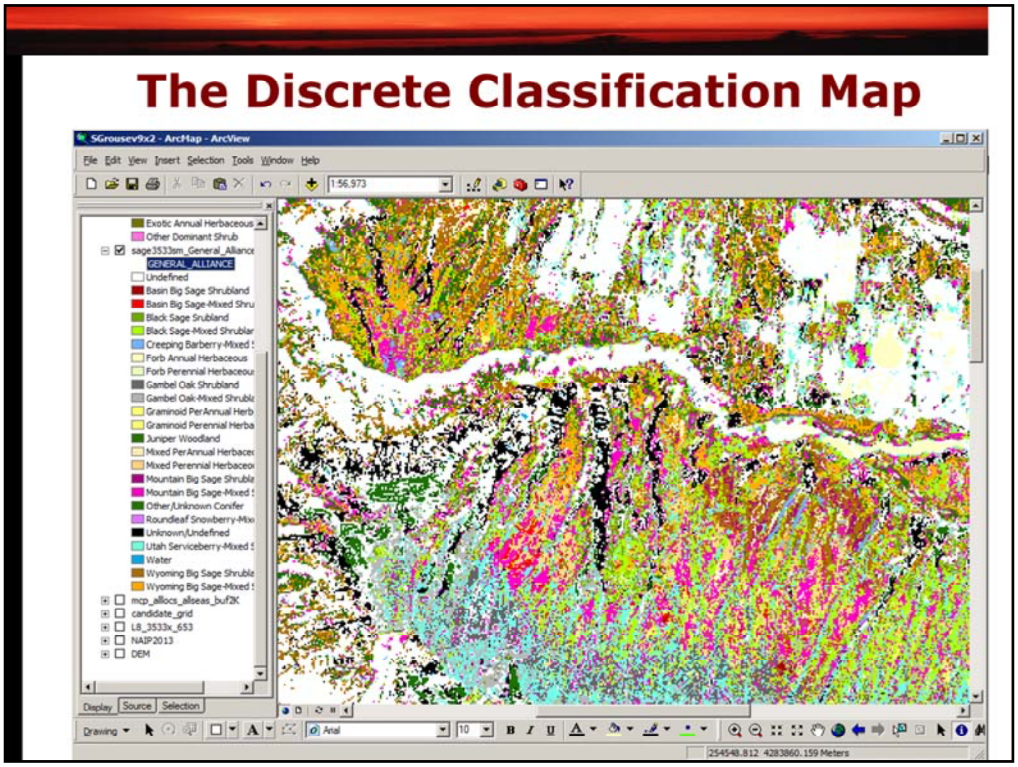
The botanist had indicated she might have miscalled the species and that it might be Black Spruce !!!!!!

While the botanist was uncertain, our QC processes identified the problem and indicated a need to correct the species to resolve it !



The DCMM map was comprised of 170 pixel classes.

We need to transform these classes into stands that all meet the Minimum Mapping Unit size limit(s).



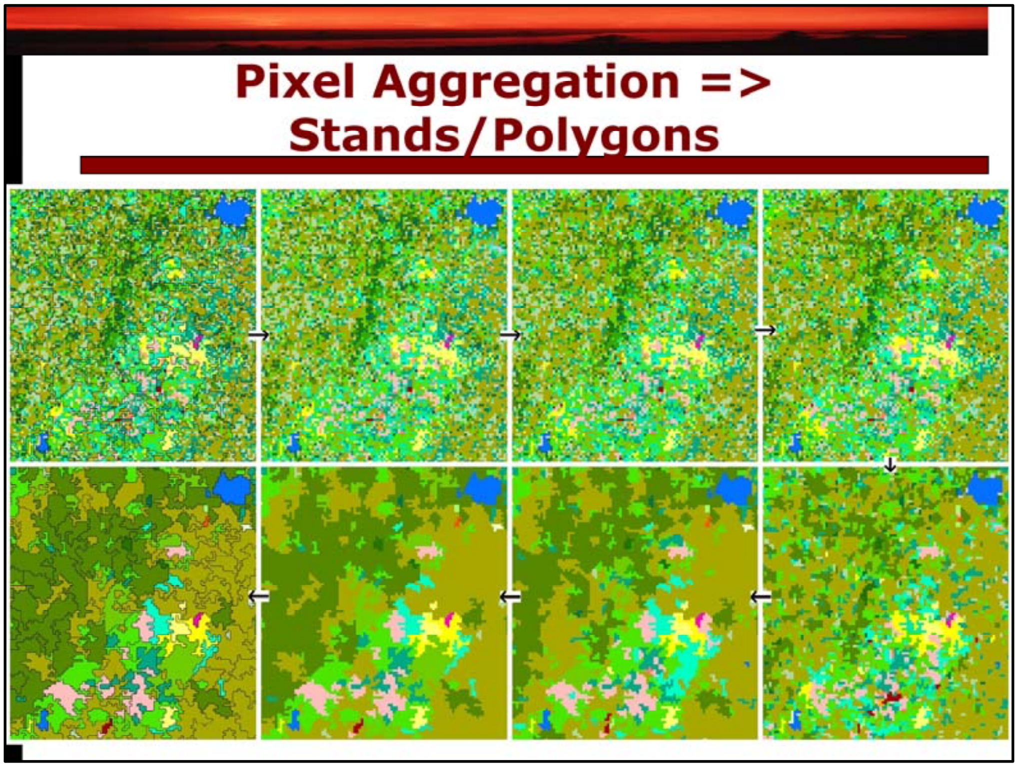
Here is the resulting pixel classmap symbolized by alliance

So how do we build the stand map.

THIS CAN BE A BIG BIG PROBLEM!!!!!!!!!!!!!!

Key reason people use eCognition and gave up on this type of approach.

However, recognize that Segmentation has been around since 1980's – nothing new.

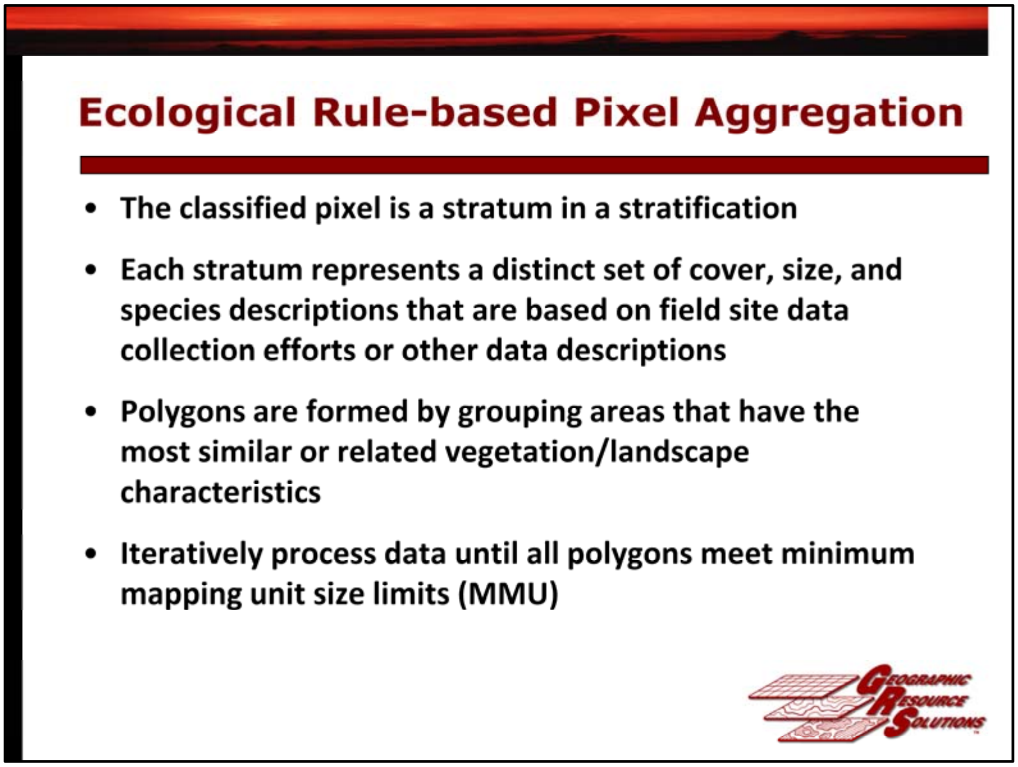


We use the detailed species-specific cover data to form groups of “similar” and dissimilar pixels that will eventually form stands, which all meet the minimum mapping size limit.

(This step can be replaced by using the boundaries created using an object oriented classification approach,

but I think this approach is better as it is based on plant community characteristics rather than spectral data).

It can also be replaced using hand drawn photointerpreted boundary linework.

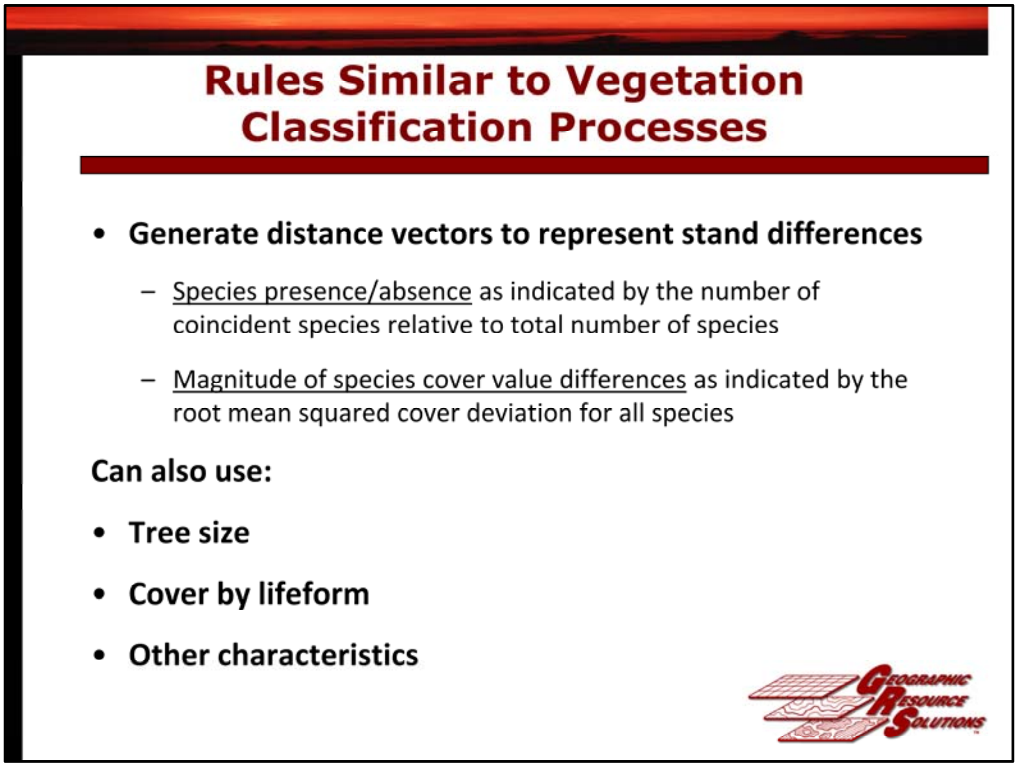


Each Pixel Class = stratum

Each Pixel Class has attribute values

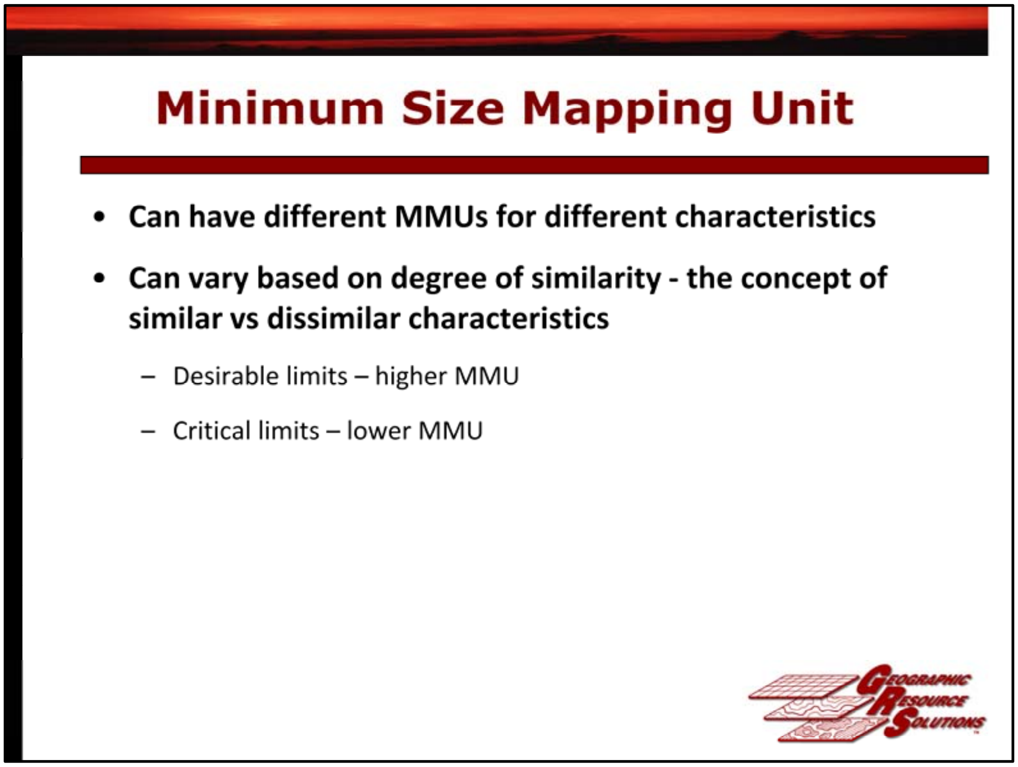
We group pixels based on the similarity of their values

We continue grouping pixels into groups of pixels (stands) until all groups meet the MMUs



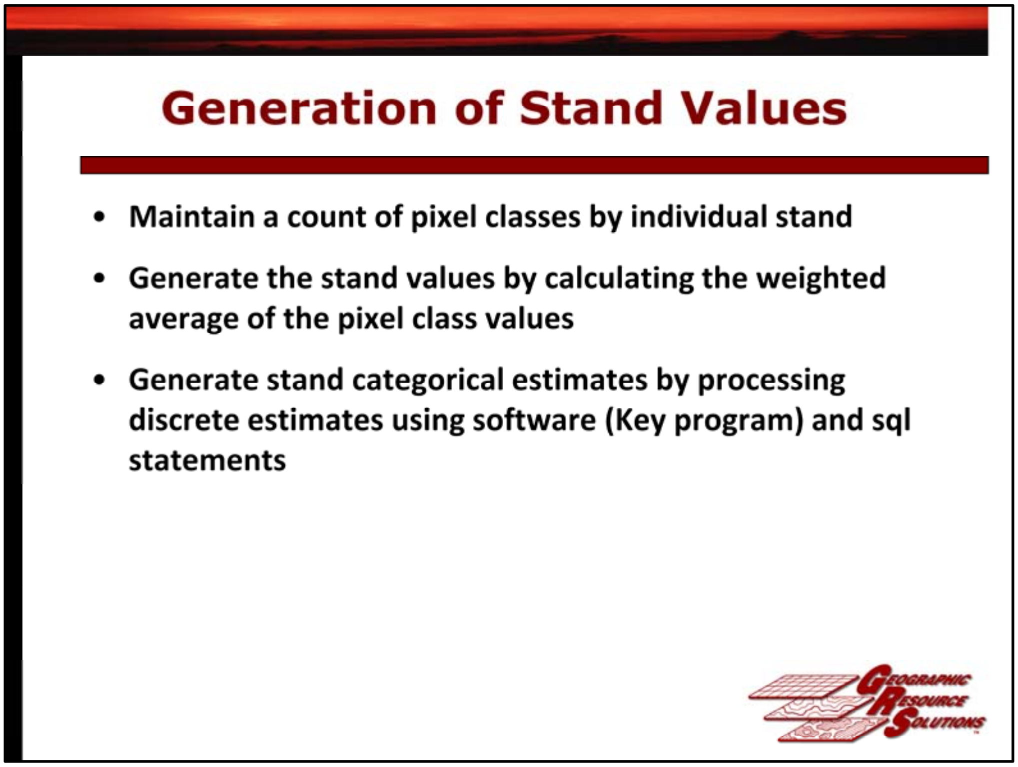
Similarity is based on a distance vector, just like Ordination

The smaller the vector, the more similar the stands being compared.



See slide …

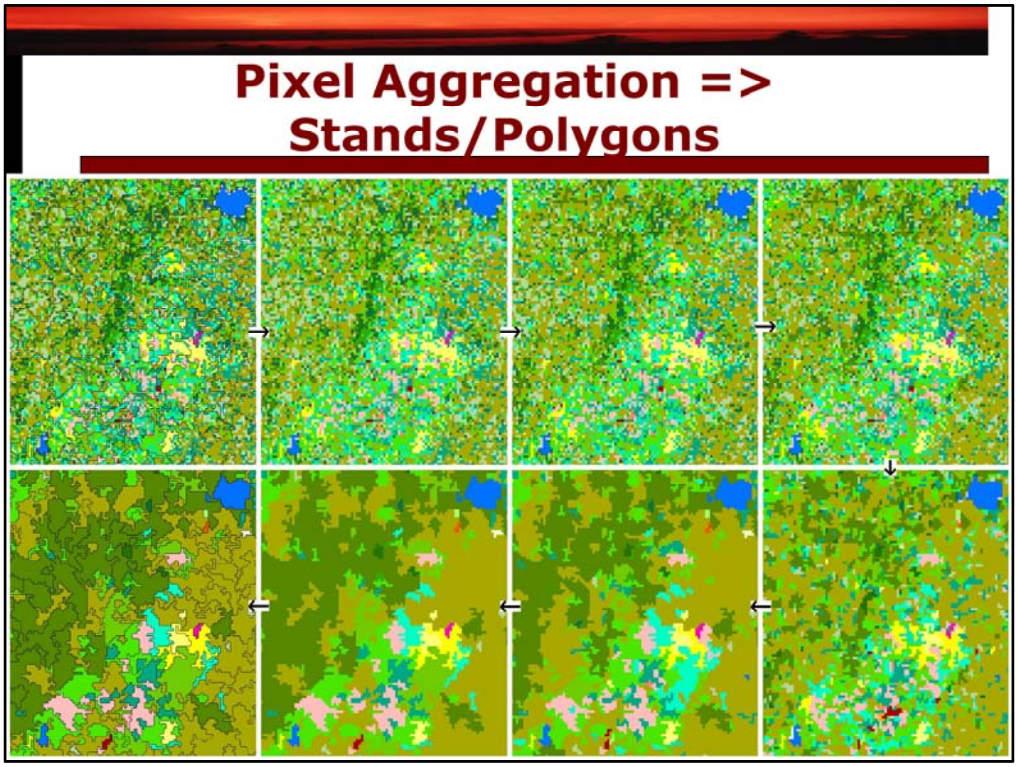
We do not want to merge dissimilar areas, if we can help it.



We can generate a frequency distribution of the different pixel class values that comprise each stand.

We develop stand cover estimates by simply calculating the weighted average of the different pixel class values

that comprise each individual stand.



The process is iterative and looks like this if we interrupt it and map the intermediate results as we process the data.

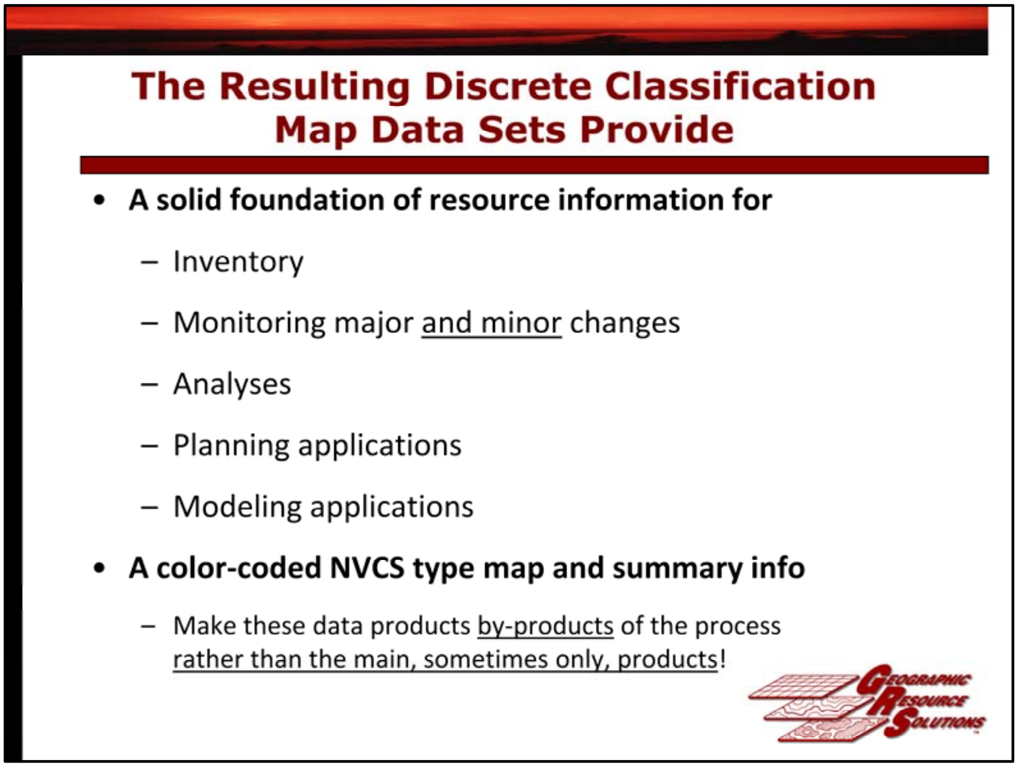
The end map (left bottom) is the one map in which all stands meet the MMU limits for the characteristics of that stand.

{read slide}

Not a remote sensing approach

Integrated …

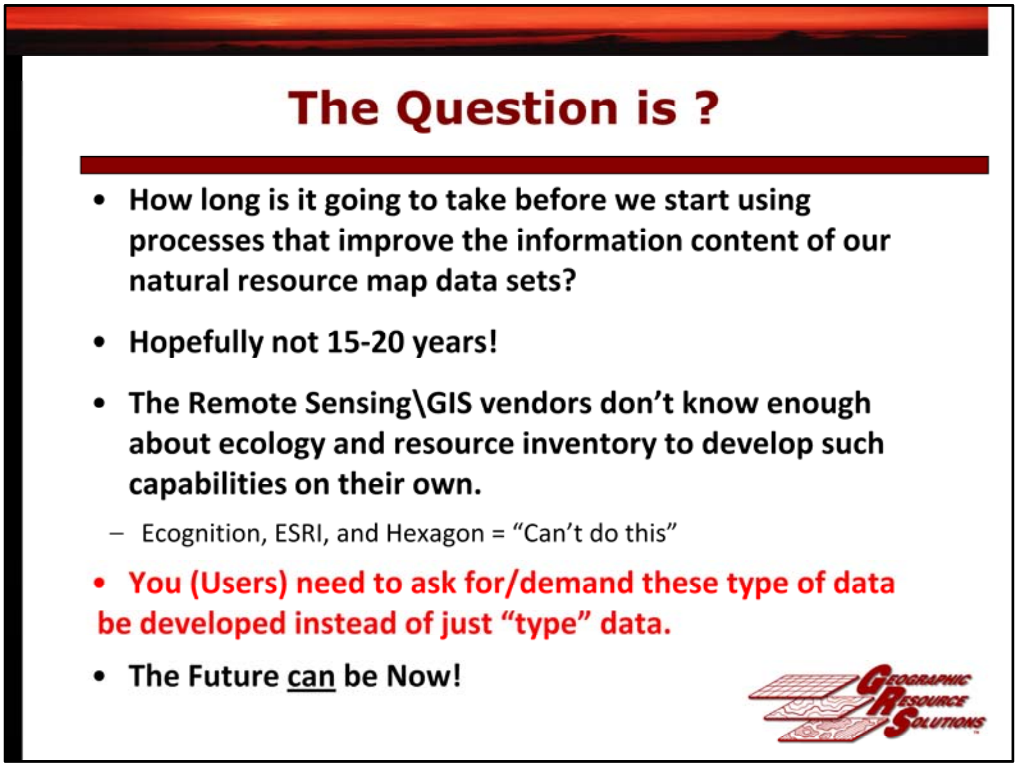
Can reduce pressure of budgetary constraints …



In summary, this Discrete Classification map data set has many benefits relative to the traditional generalized approach.

Let the generalized color-coded type map be a by-product of this mapping process rather than the main product.

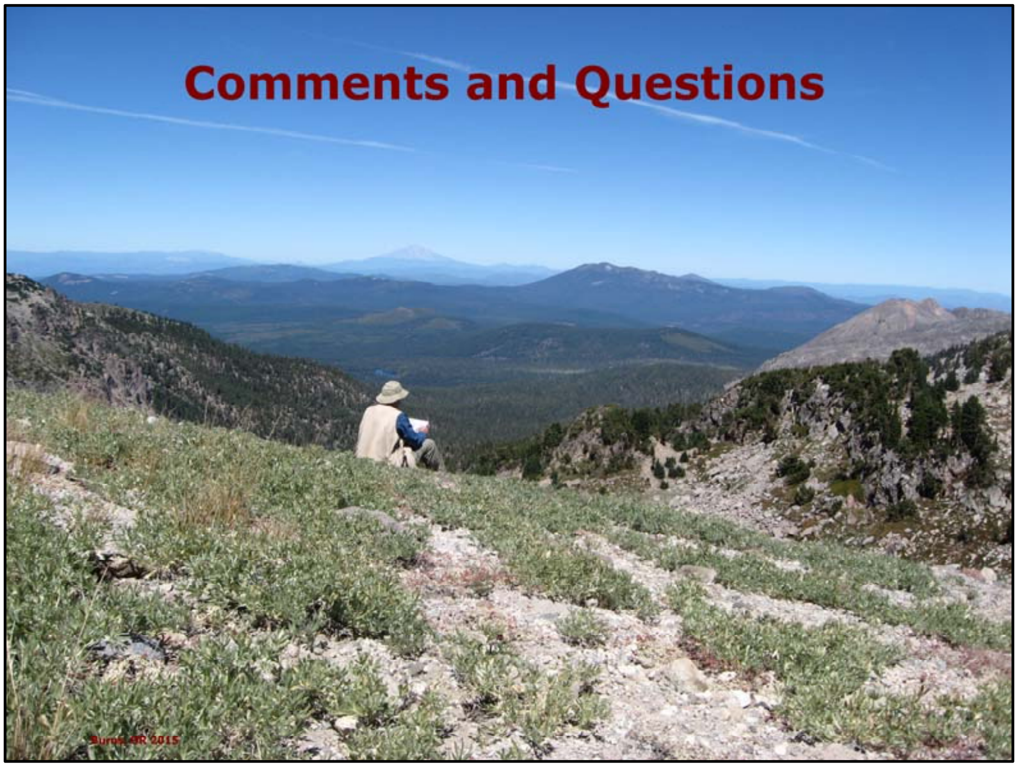
These detailed map data sets will likely form the basis for monitoring the gradual changes in some species that may be occur associated with future climatic changes.



My opinion is the vendors are now mostly massaging interfaces and providing new ways to access their software … as the analytical GIS tools we have been using haven't changed in a long time …

GIS/Remote Sensing staff and Vendors won't magically provide these new types or levels of information to you (users) until you (users) start to ask/demand these type of resource information.

However, based on our efforts, we don't need to wait any longer to have species/landscape-specific estimates.


Comments and Questions