Ecosystem Indicators

2009 MSHCP Symposium

PI: Dr. Jill S. Heaton
University of Nevada, Reno
Department of Geography
jheaton@unr.edu

Project Manager: Lee Bice
Clark County MSHPC

University of Nevada, Reno

Project Deliverables

- Processed Quickbird Imagery
  - April, ‘09
- County wide Vegetation Ecosystem Model
  - Interim March ‘10
  - Final Nov ‘10
- County wide Geomorphology Model
  - Interim Dec ‘09
  - Final March ‘10
- Pilot Vegetation Ecosystem Model
  - Interim Aug ‘10
  - Final Nov ‘10

Project Team

- Dr. Kyle House and Ms. Heather Green; UNR Nevada Bureau of Mines and Geology
- Drs. Pat Cashman and Jim Trexler; UNR Geologic Sciences
- Dr. Xin (Shane) Miao; Missouri State Geography
- Dr. David Charlet; CSN Biology
- Dr. Karin Hoff and Mr. Rohit Patil; UNR Geography
- Ms. Abbey Grimmer, students and staff; UNR Geo-Spatial Lab
- Mr. Lee Bice, MSHCP Project Manager

Ecosystem Model Overview

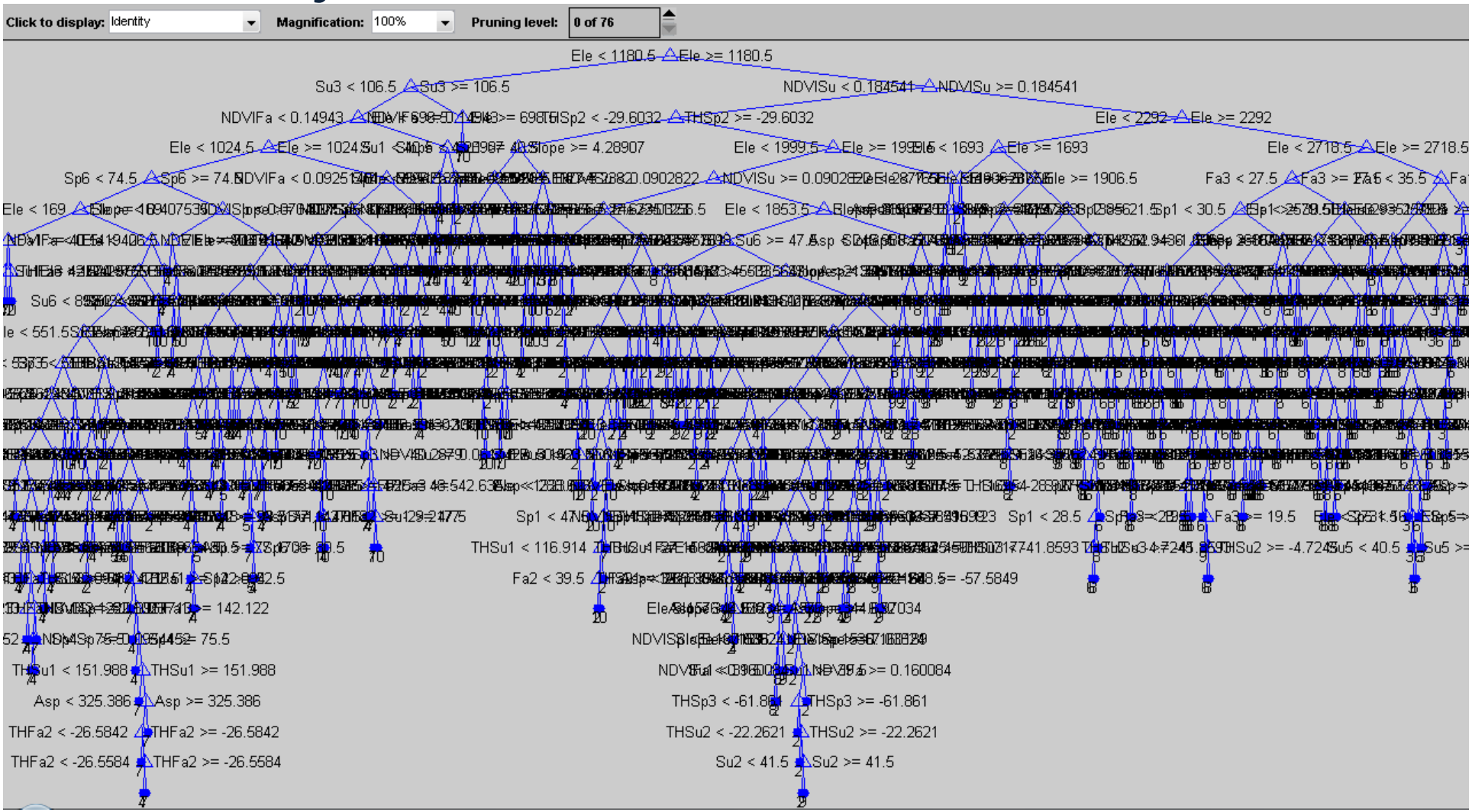
- 11 Ecosystems as defined by the MSHPC
- Hierarchical and model based classification approach (e.g. Mesquite Dune v. Mesquite Riparian)
- Not creating a Yucca“ecosystem”, but embedding Yucca distribution model into the ecosystem model (e.g. Mojave Desert Scrub with Jtree over story)

Ecosystem Model Approach

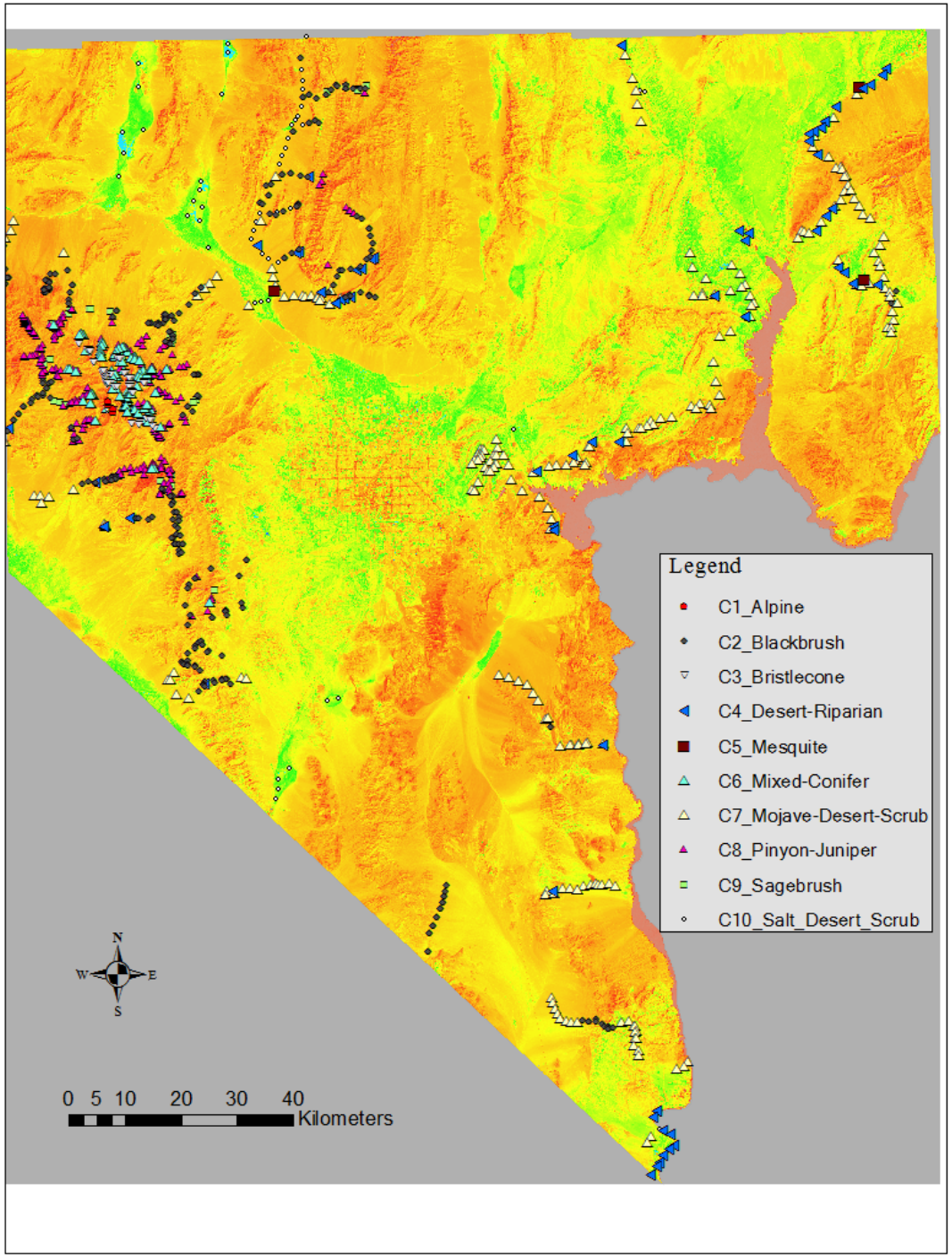
- Computer Modeling
  - Algorithms
    - Machine learning methods (e.g. CART; Neural Networks; discriminant analysis; SVM; Bagging Decision Tree)
  - Data
    - Incorporates topographic information (i.e. elevation, slope and aspect)
    - Transformations: NDVI and Tassel Hat
    - RS Imagery: ETM, TM, Quickbird
    - Multi-time frame imagery (Summer, Fall, Spring)
  - Parameters
    - E.g. Elevation constraints (i.e. BCP >8000ft)
- Old Fashioned ground mapping (i.e. mesquite/acacia)
- Field Work
  - Existing field data (e.g. GAP; MSHCP projects)
  - Quick and dirty fly by plots (over 1000 this late spring and summer)
  - Detailed vegetation plots randomly located

Computer Modeling

CART Fully Grown Tree

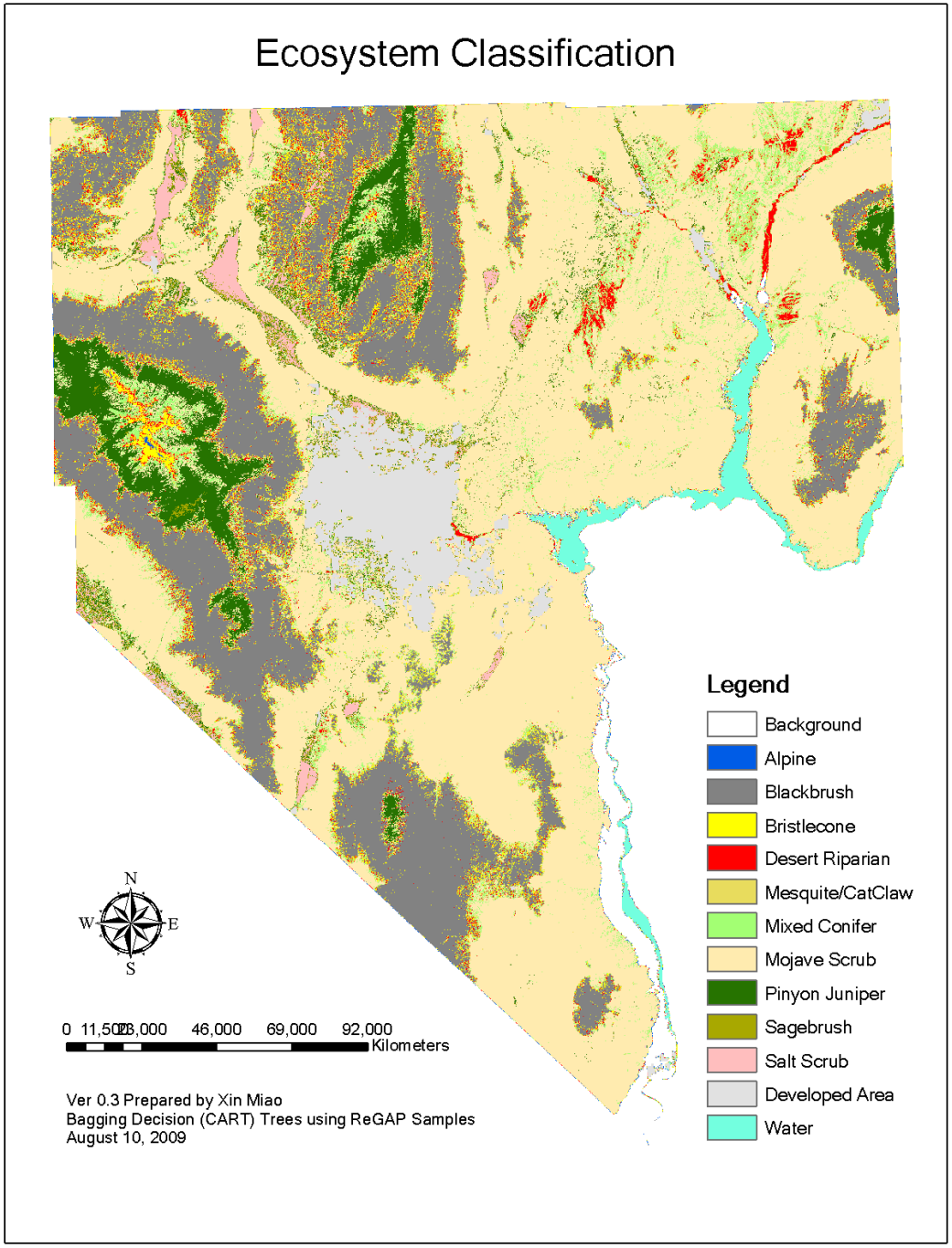


ReGAP Field Work

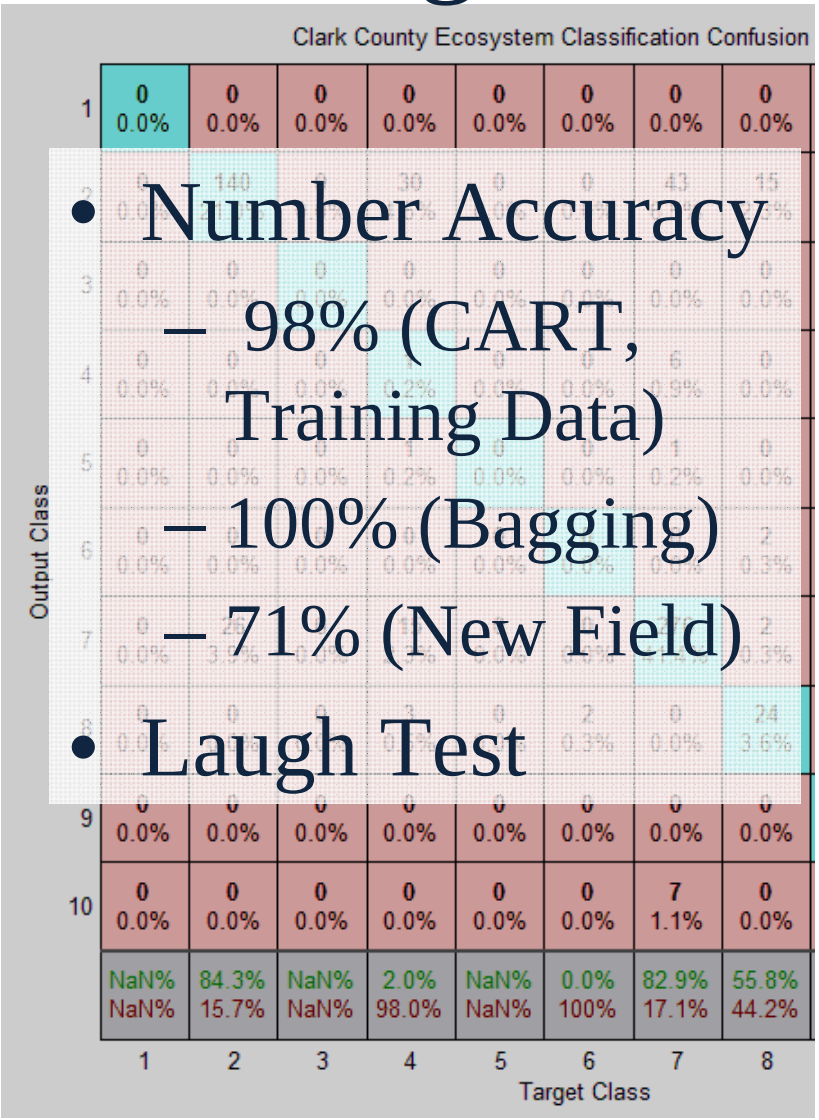


Computer Modeling

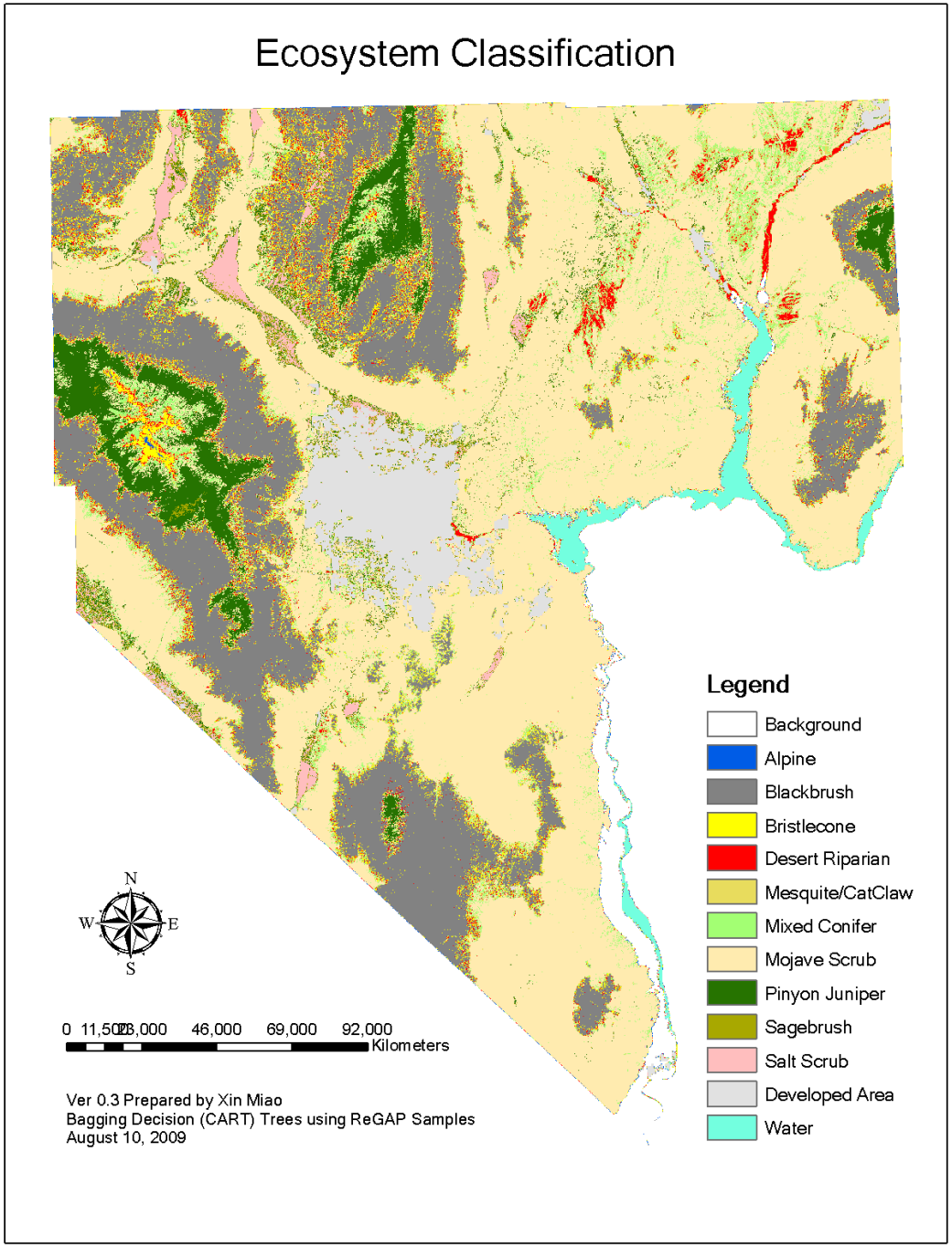
- Elevation, Slope and Aspect (3)
- 3 ETM Images (18)
- NDVI (3)
- Tassel Hat (9)
- 33 Input Layers

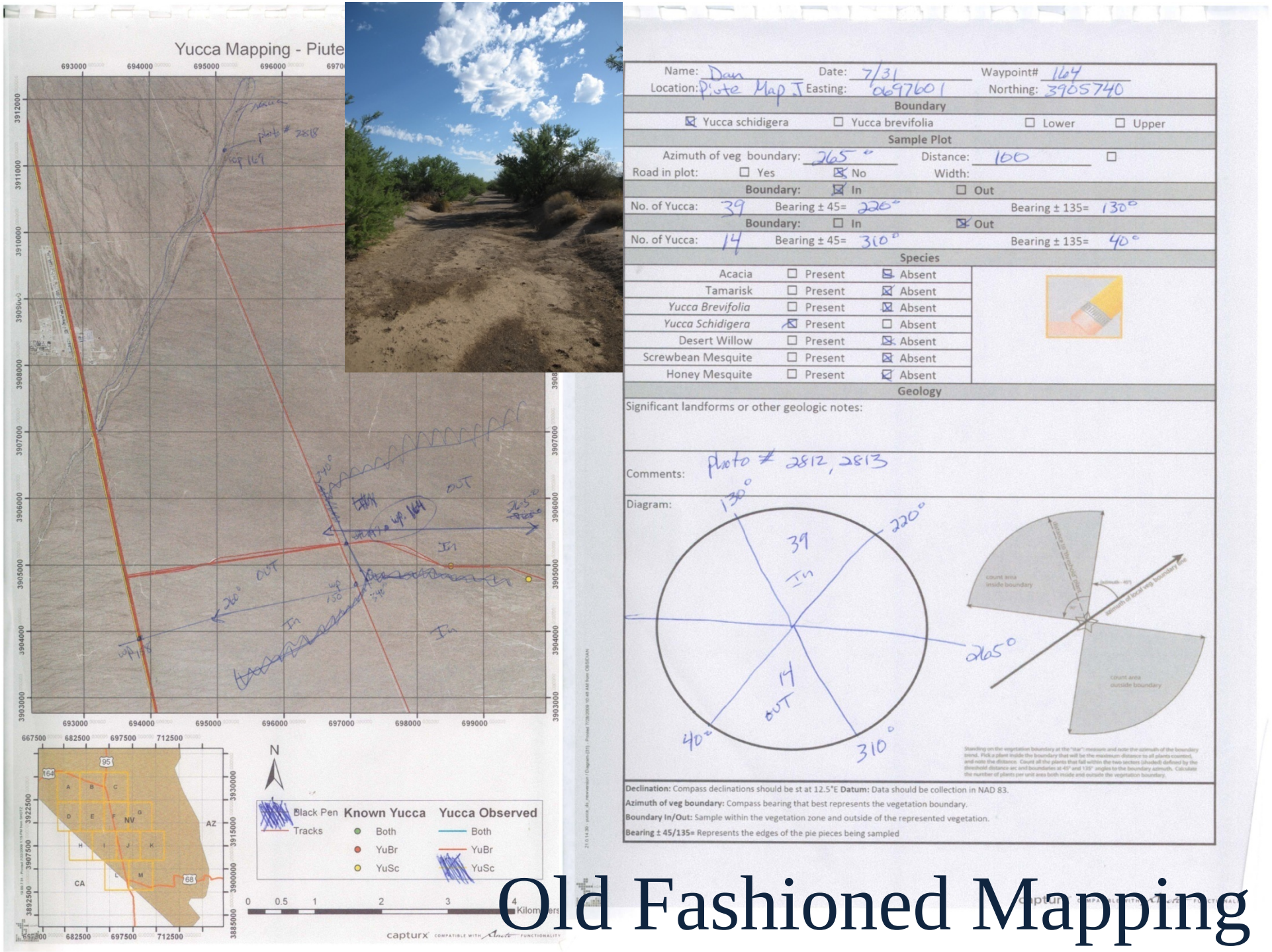


Computer Modeling

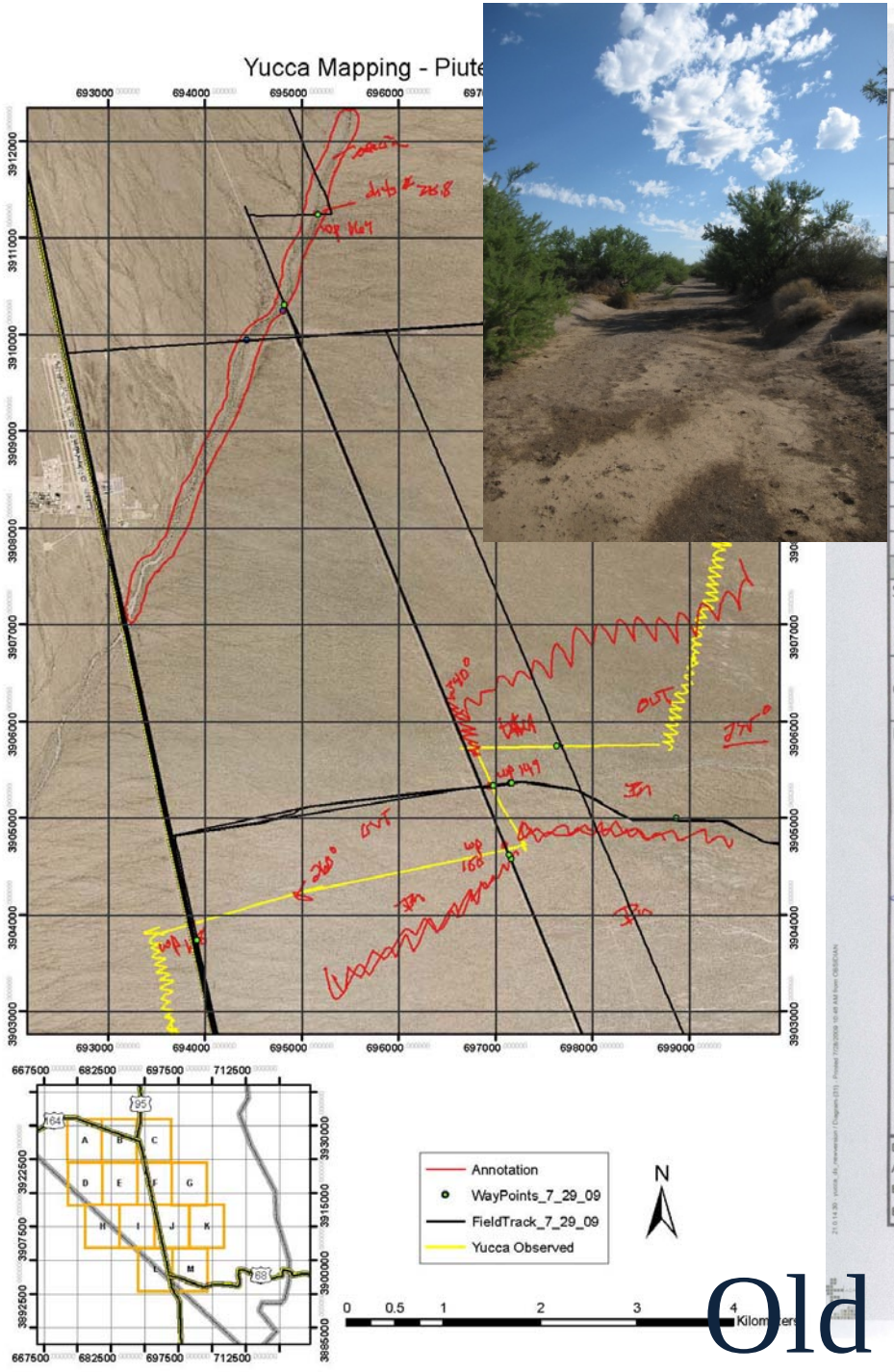


- Number Accuracy
  - 98% (CART, Training Data)
  - 100% (Bagging)
  - 71% (New Field)
- Laugh Test





Old Fashioned Mapping



Name: Dan Date: 7/31 Waypoint# 164
Location: Piute Map J Easting: 0697601 Northing: 3905740

Boundary

☒ Yucca schidigera ☐ Yucca brevifolia ☐ Lower ☐ Upper

Sample Plot

Azimuth of veg boundary: 265° Distance: 100 ☐
Road in plot: ☐ Yes ☒ No Width:

Boundary: ☒ In ☐ Out

No. of Yucca: 39 Bearing ± 45= 220° Bearing ± 135= 130°

Boundary: ☐ In ☒ Out

No. of Yucca: 14 Bearing ± 45= 310° Bearing ± 135= 40°

Species

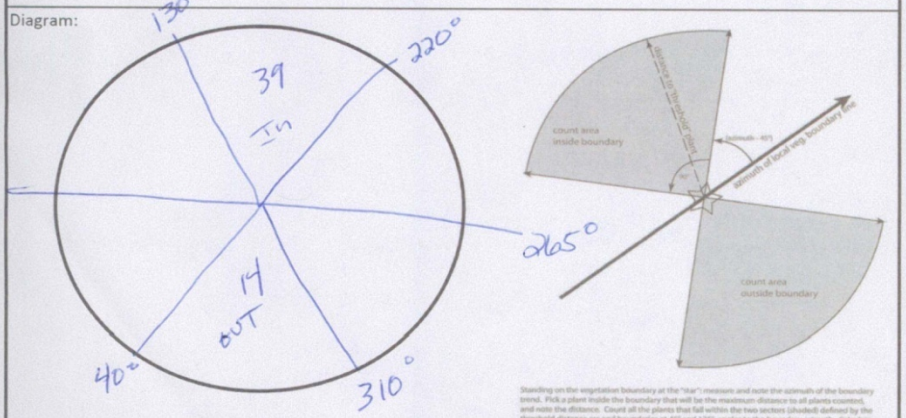
Acacia	☐ Present	☒ Absent
Tamarisk	☐ Present	☒ Absent
Yucca Brevifolia	☐ Present	☒ Absent
Yucca Schidigera	☒ Present	☐ Absent
Desert Willow	☐ Present	☒ Absent
Screwbean Mesquite	☐ Present	☒ Absent
Honey Mesquite	☐ Present	☒ Absent

Geology

Significant landforms or other geologic notes:

Comments: photo # 2812, 2813

Diagram:



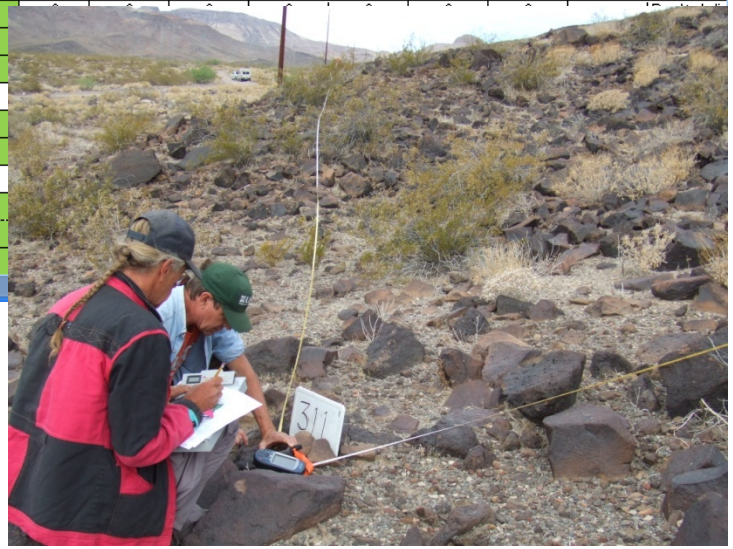
Declination: Compass declinations should be st at 12.5°E **Datum:** Data should be collection in NAD 83.
Azimuth of veg boundary: Compass bearing that best represents the vegetation boundary.
Boundary In/Out: Sample within the vegetation zone and outside of the represented vegetation.
Bearing ± 45/135= Represents the edges of the pie pieces being sampled

Old Fashioned Mapping

Charlet_WayPoints_913.xls [Compatibility Mode] - Microsoft Excel

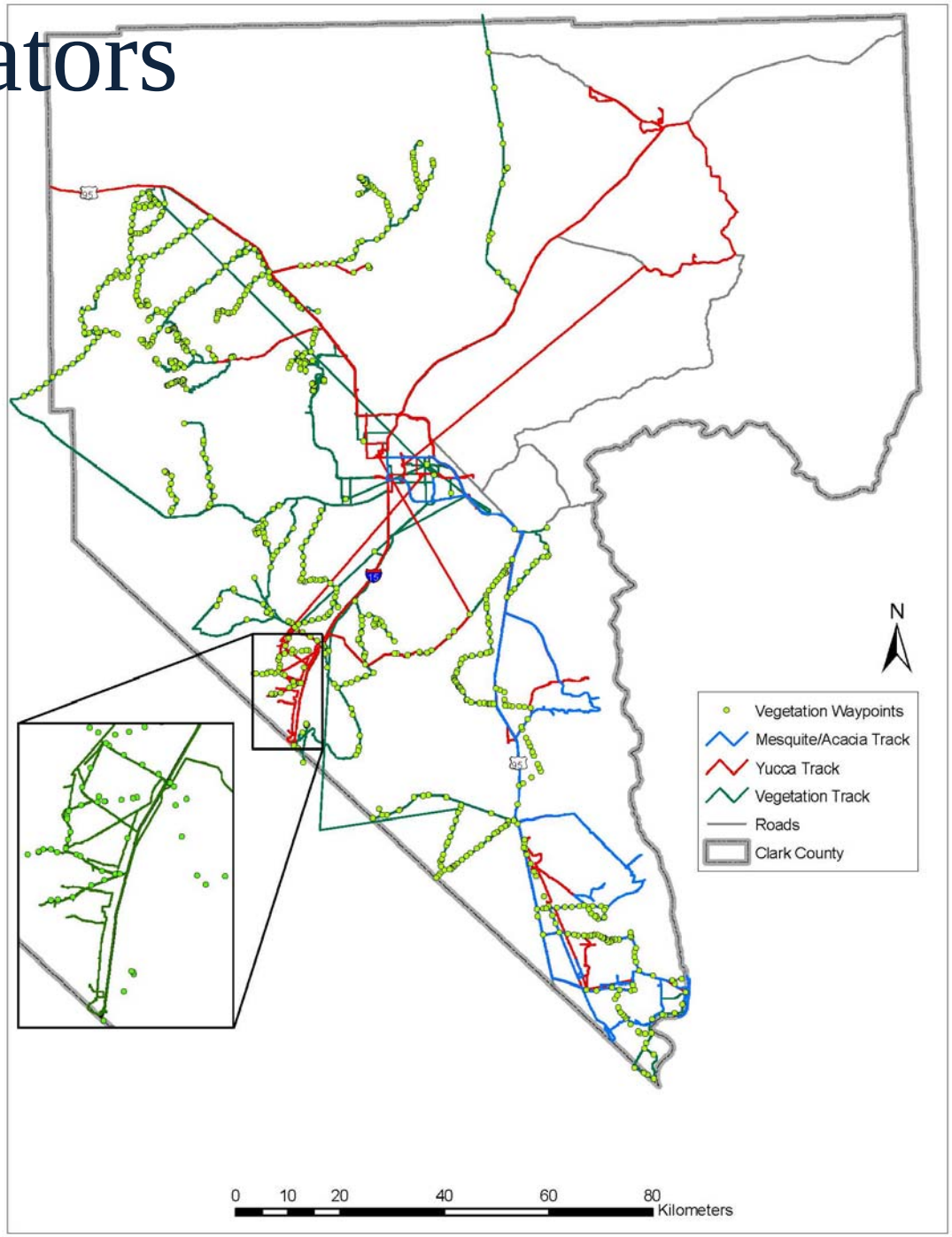
	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	
1	Association below or surrounding	Vegetation Association	Association above or surrounding	MSHCP Ecosystem Observed	OBSERVED MSHCP ECOSYSTEM CODE	OBSERVED MSHCP ZONE	Yucca schidigera	Yucca brevifolia	Bedrock Azonal Ecosystem Component	Dunes Azonal Ecosystem Component	Spring Azonal Ecosystem Component	Mesquite-Catclaw Ecosystem Component	Desert Pavement Ecosystem Component	Number MSHCP Species Observed	MSHCP SPE	COMMENTS
413	JUOS-PIMO-YUBR/ARTRT-YUBA-EPVI/CORA-GUMI	JUOS-PIMO-YUBR/ARTRT-YUBA-EPVI/CORA-GUMI	JUOS-PIMO-YUBR/ARTRT-YUBA-EPVI/CORA-GUMI	BLACKBRUSH	BB	BB	0	1	1	0	0	0	0	0	.	Wash, E aspe
414	JUOS-PIMO-YUBR/PRFA-ARNO-	JUOS-PIMO-YUBR/PRFA-ARNO-	JUOS-PIMO-YUBR/PRFA-ARNO-	BLACKBRUSH	BB	BB	0	1	1	0	0	0	0	1	Glossopetal	Limestone be
415	JUOS-PIMO/-YUBR/CORA-ARNO-	JUOS-PIMO/-YUBR/CORA-ARNO-	JUOS-PIMO/-YUBR/CORA-ARNO-	Blackbrush-Pinyon/Juniper transition	BB-PJ	BB-PJ	0	1	0	0	0	0	0	0	.	Hydrologicaly
416	ENVI/CORA-YUBA	ENVI/CORA-YUBA	ENVI/CORA-YUBA	BLACKBRUSH	BB	BB	0	1	0	0	0	0	0	0	.	With PUST, J
417	PIMO-JUOS/ARNO-CORA-EPVI	PIMO-JUOS/ARNO-CORA-EPVI	PIMO-JUOS/ARNO-CORA-EPVI	Blackbrush-Pinyon/Juniper transition	BB-PJ	BB-PJ	0	1	0	0	0	0	0	0	.	Back on mou
418	PIMO-JUOS/ARNO-EPVI	PIMO-JUOS/ARNO-EPVI	PIMO-JUOS/ARNO-EPVI	PINYON-JUNIPER	PJ	PJ	0	0	0	0	0	0	0	0	.	N aspect. Pir
419	JUOS-PIMO/ARNO-EPVI/ACSP	JUOS-PIMO/ARNO-EPVI/ACSP	JUOS-PIMO/ARNO-EPVI/ACSP	PINYON-JUNIPER	PJ	PJ	0	0	0	0	0	0	0	0	.	N aspect. Pir
420	PIMO-JUOS/PUST/ARNO-EPVI	PIMO-JUOS/PUST/ARNO-EPVI	PIMO-JUOS/PUST/ARNO-EPVI	PINYON-JUNIPER	PJ	PJ	0	0	1	0	0	0	0	1	Erigeron clok	Near Lucky S
421	PIMO-JUOS/PUST/ARNO-CORA	PIMO-JUOS/PUST/ARNO-CORA	PIMO-JUOS/PUST/ARNO-CORA	PINYON-JUNIPER	PJ	PJ	0	0	0	0	0	0	0	0	.	N aspect. Olc
422	Developed	Developed	Developed	Developed	Devel	MDS	0	0	0	0	0	0	0	0	.	Detention ba
423	LATR/AMDU-ATCO	LATR/AMDU-ATCO	LATR/AMDU-ATCO	MOJAVE DESERT SCRUB	MDS	MDS	1	0	0	0	0	0	0	0	.	Road S of de
424	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1	0	0	0	0	0	0	0	.	With ATCO, C
425	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	0	0	0	0	0	0	0	0	.	With Echinoc
426	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1	0	1	0	0	0	0	0	.	Northernmos
427	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	0	0	0	0	0	0	0	0	.	Canyon flats
428	PRFA/BUUT/ACSP	PRFA/BUUT/ACSP	PRFA/BUUT/ACSP	MOJAVE DESERT SCRUB	MDS	MDS	1	0	1	0	0	0	0	0	.	Limestone be
429	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1	0	0	0	0	0	1	0	.	A little valley
430	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1	0	0	0	0	0	1	0	.	Desert paven
431	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1	0	0	0	0	0	0	0	.	Limestone cc
432	AMDU-KRLA-BUUT	AMDU-KRLA-BUUT	AMDU-KRLA-BUUT	MOJAVE DESERT SCRUB	MDS	MDS	1	0	1	0	0	0	0	0	.	Mountain val
433	HYSA-PENI	HYSA-PENI	HYSA-PENI	DESERT RIPARIAN	DR	MDS	1	0	0	0	0	0	0	0	.	Major wash.
434	LATR/AMDU-EPTO	LATR/AMDU-EPTO	LATR/AMDU-EPTO	MOJAVE DESERT SCRUB	MDS	MDS	1	0	1	0	0	0	0	0	.	Limestone be
435	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1	0	0	0	0	0	0	0	.	With YUSC, A
436	LATR/AMDU-ATCO	LATR/AMDU-ATCO	LATR/AMDU-ATCO	MOJAVE DESERT SCRUB	MDS	MDS	1	0	0	0	0	0	1	0	.	Near little pas
437	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1	0	0	0	0	0	1	0	.	Desert paven
438	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1	0	0	0	0	0	1	0	.	Some desert
439	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1									
440	LATR/AMDU	LATR/AMDU	LATR/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1									
441	YUSC/LATR/AMDU-KRER	YUSC/LATR/AMDU-KRER	YUSC/LATR/AMDU-KRER	MOJAVE DESERT SCRUB	MDS	MDS	1									
442	YUSC/PSFR/BUUT-KRLA-GUMI	YUSC/PSFR/BUUT-KRLA-GUMI	YUSC/PSFR/BUUT-KRLA-GUMI	MOJAVE DESERT SCRUB	MDS	MDS	0									
443	YUSC/AMDU	YUSC/AMDU	YUSC/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1									
444	AMDU-PSFR-ACSH-MESP	AMDU-PSFR-ACSH-MESP	AMDU-PSFR-ACSH-MESP	MOJAVE DESERT SCRUB	MDS	MDS	1									
445	ERPA/HYSA-SADO-ENVI	ERPA/HYSA-SADO-ENVI	ERPA/HYSA-SADO-ENVI	DESERT RIPARIAN	DR	MDS	0									
446	YUBR/LATR-EPNE/AMDU	YUBR/LATR-EPNE/AMDU	YUBR/LATR-EPNE/AMDU	MOJAVE DESERT SCRUB	MDS	MDS	1									
447	YUSC/FECY/PSFR	YUSC/FECY/PSFR	YUSC/FECY/PSFR	MOJAVE DESERT SCRUB	MDS	MDS	1									
448	YUBR/LATR-YUSC/KRER	YUBR/LATR-YUSC/KRER	YUBR/LATR-YUSC/KRER	MOJAVE DESERT SCRUB	MDS	MDS	1									

WayPointData | Metadata | summary



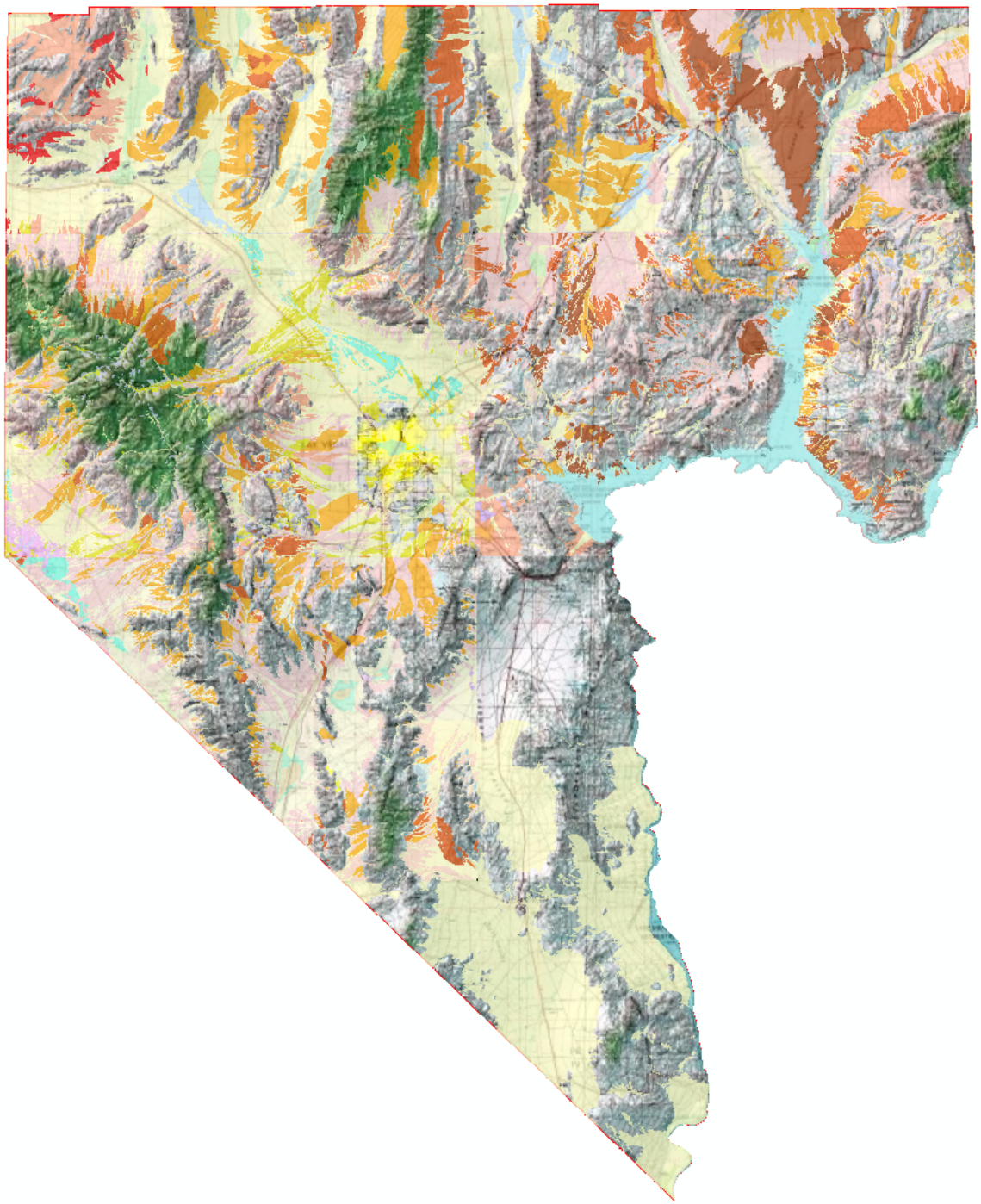
Ecosystem Indicators Field Work

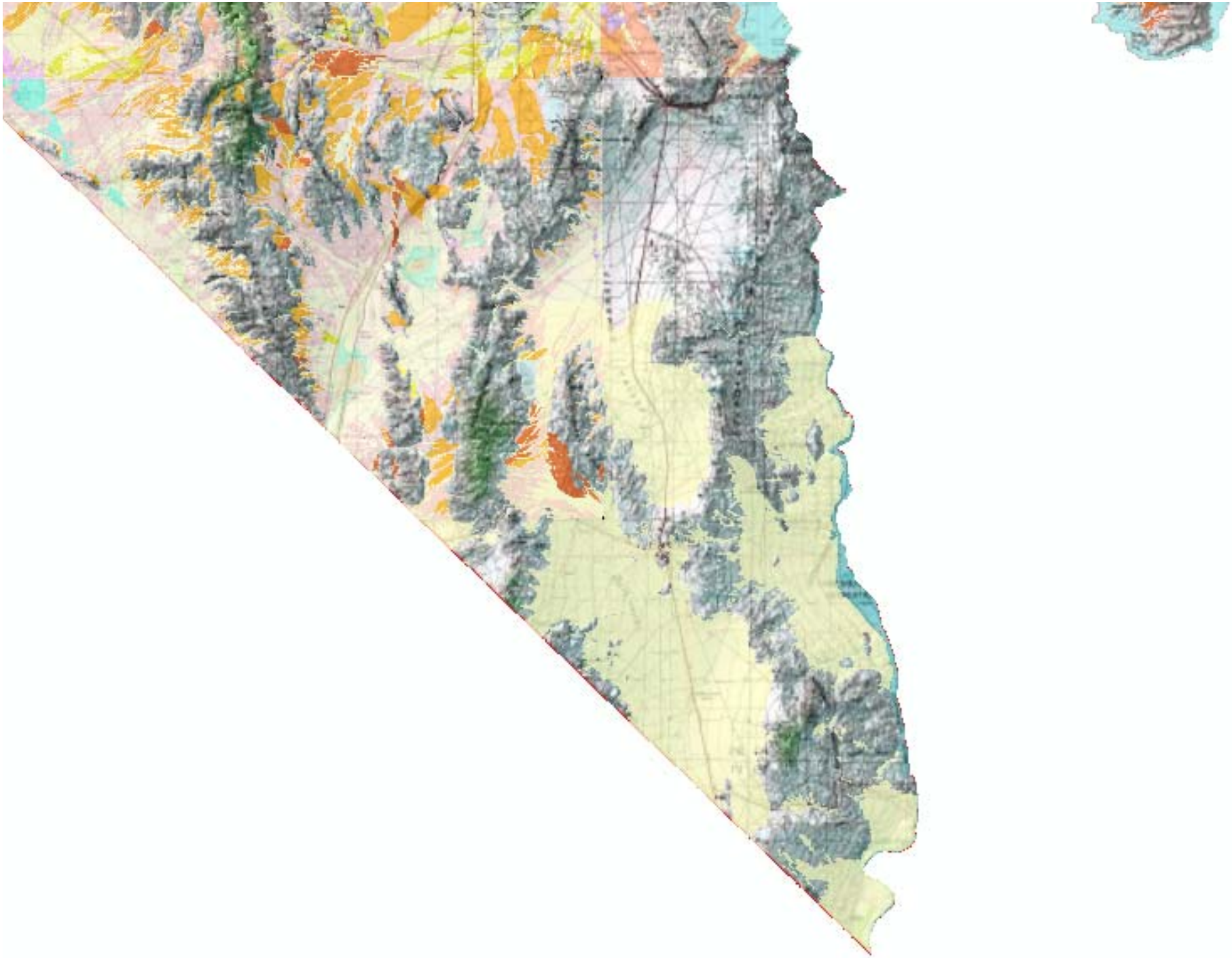
Ecosystem Indicators Field Work

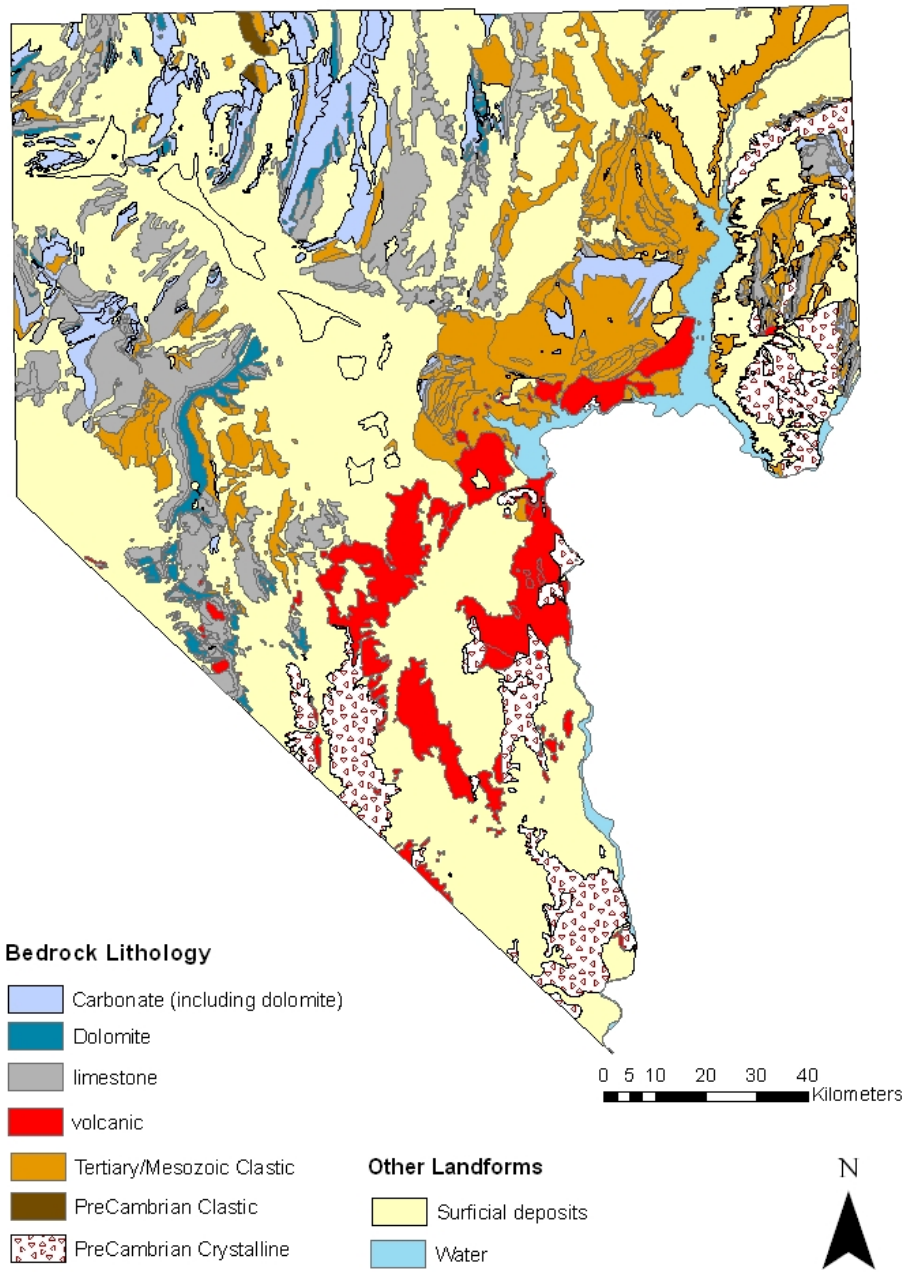


Geomorphology Overview and Modeling Approach

- Model of landform/surface materials (i.e. alluvial fan, wash, playa, sand dune, etc. and including surface age controls)
- Compiled through existing mapping, heads up digitizing and ground truthing.





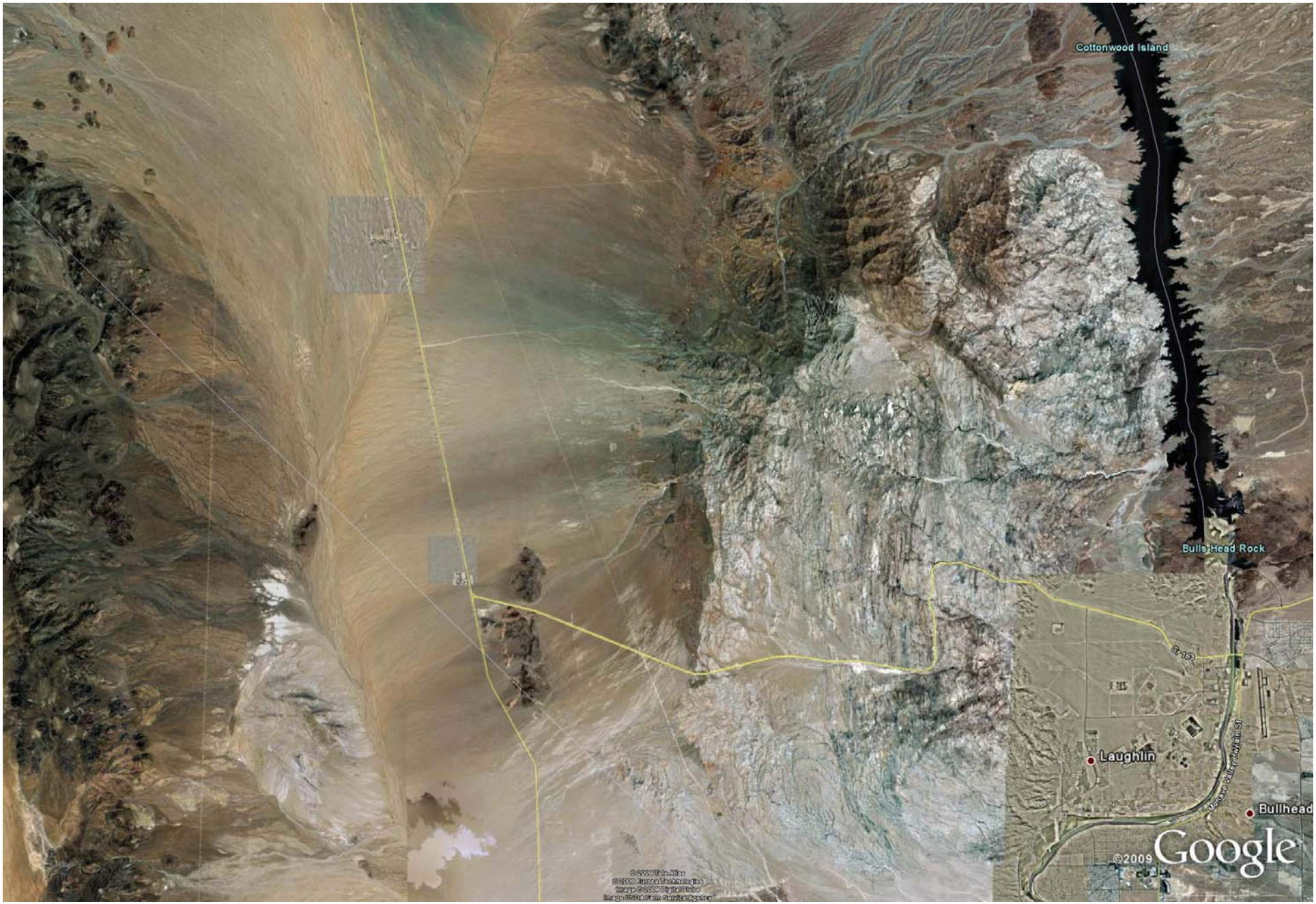

Bedrock Lithology
Carbonate (including dolomite)
Dolomite
limestone
volcanic
Tertiary/Mesozoic Clastic
PreCambrian Clastic
PreCambrian Crystalline
Other Landforms
Surficial deposits
Water
0 5 10 20 30 40
Kilometers
N

Pilot Ecosystem Model Overview

- Limited to three geographic areas
  - Ivanpah Valley
  - Piute Valley
  - TBD
- Add to the Ecosystem Model development approach
  - Additional object-oriented classification methods
  - bedrock geology
  - geomorphology

Bedrock Lithology
Carbonate (including dolomite)
Dolomite
limestone
volcanic
Tertiary/Mesozoic Clastic
PreCambrian Clastic
PreCambrian Crystalline
Other Landforms
Surficial deposits
Water
0 5 10 20 30 40
Kilometers
N

62
Age: Qay
7%
20%
73%
chert
Limestone
Limestone with caliche
Map label 62
fan type Qay
age young
yucca b yes
yucca s yes
elevation 918m
59
Age: Qay
12%
16%
6%
66%
chert
Limestone
Basalt
Limestone with caliche
label 59
fan type Qay
age young
yucca b no
yucca s yes
elevation 914m

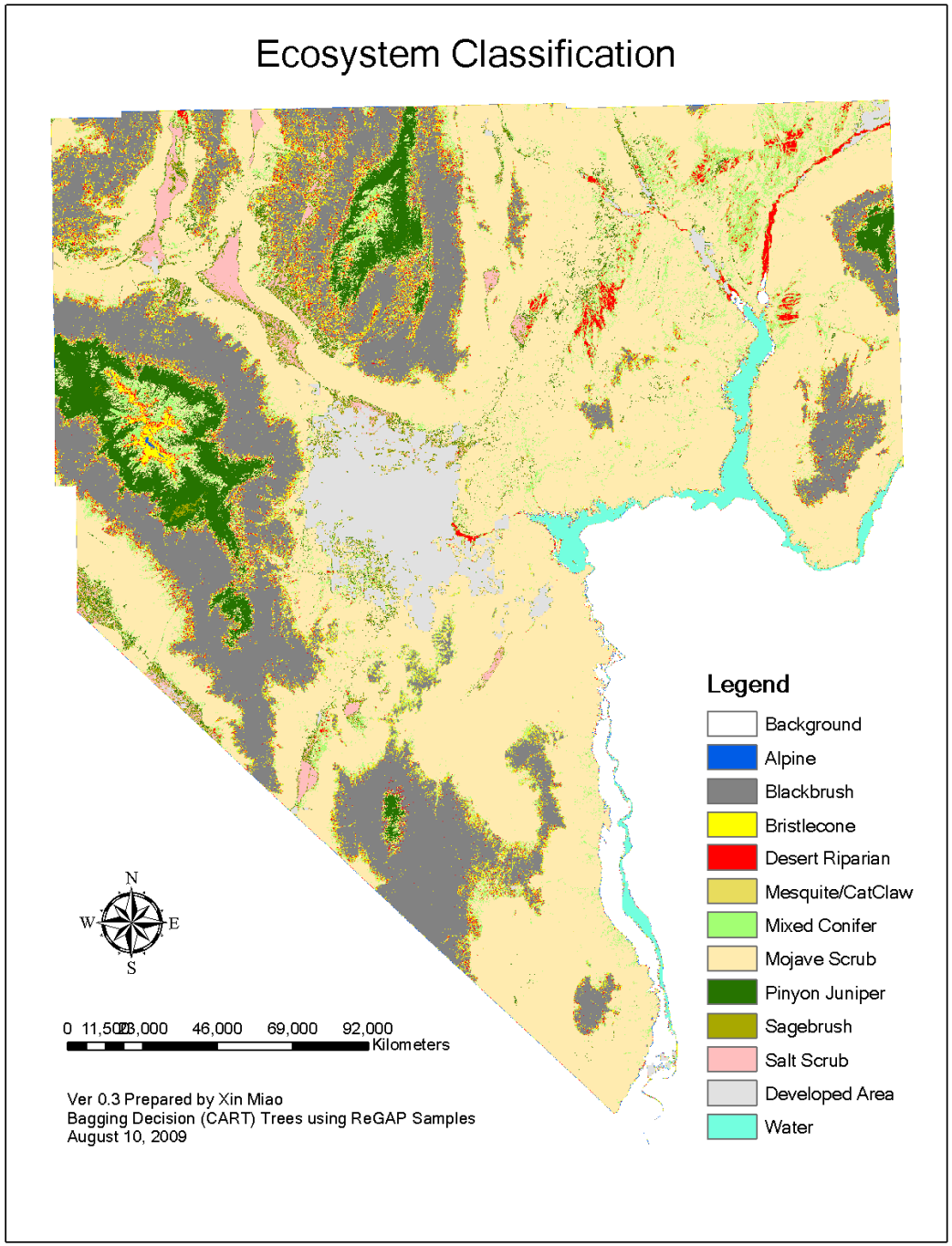

Cottonwood Island
Bulls Head Rock
Laughlin
Bullhead
©2009 Google

So, What is Our Status and Where are we Going?

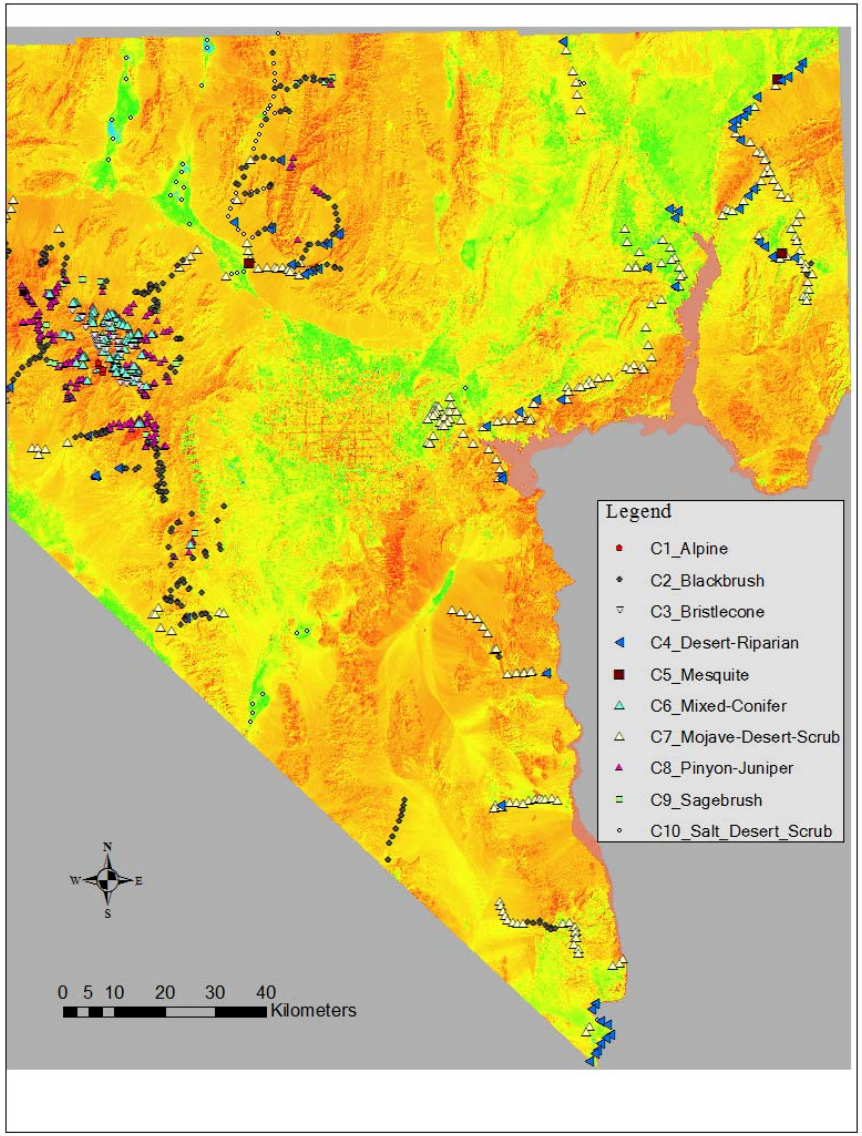
- Refining Ecosystem model algorithms (i.e. Bagging Trees), input data (i.e. geomorphology), and parameters (i.e. elevation constraints)
- Not just number error (i.e. confusion matrix) but Geographic error
- Extending vegetation field work to lower elevation ecosystems
- Running full speed ahead with compiled geomorphology data set, heads up digitizing and field work
- Compile 1:100k Bedrock Geology
- Continuing pilot work in Ivanpah and Piute Valley's to explore relationship between Bedrock Geology, Surficial Geomorphology and Vegetation Distribution

Questions?

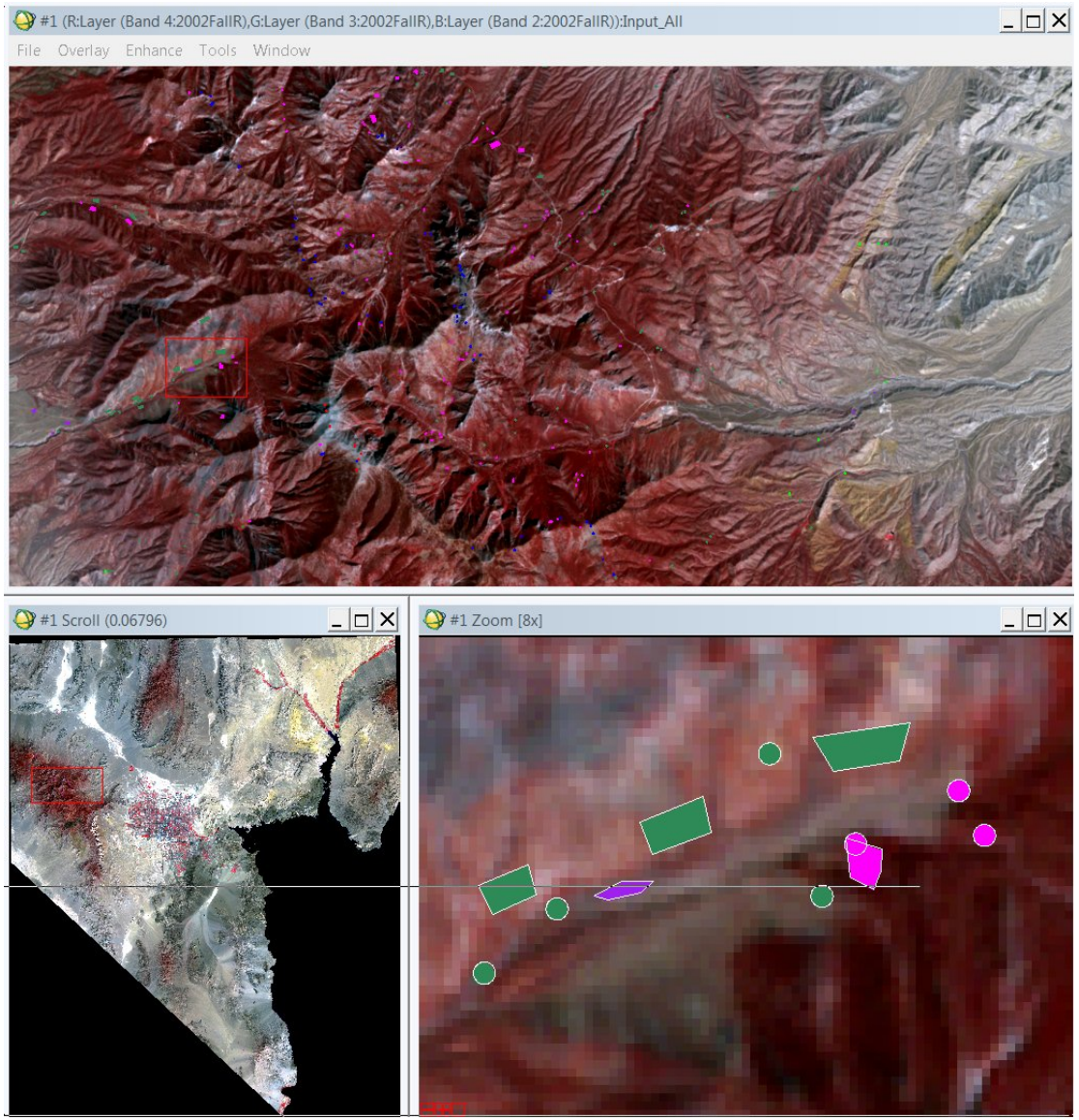
Questions?


Ecosystem Classification
Legend
Background
Alpine
Blackbrush
Bristlecone
Desert Riparian
Mesquite/CatClaw
Mixed Conifer
Mojave Scrub
Pinyon Juniper
Sagebrush
Salt Scrub
Developed Area
Water
N
W
E
S
0 11,500 23,000 46,000 69,000 92,000
Kilometers
Ver 0.3 Prepared by Xin Miao
Bagging Decision (CART) Trees using ReGAP Samples
August 10, 2009

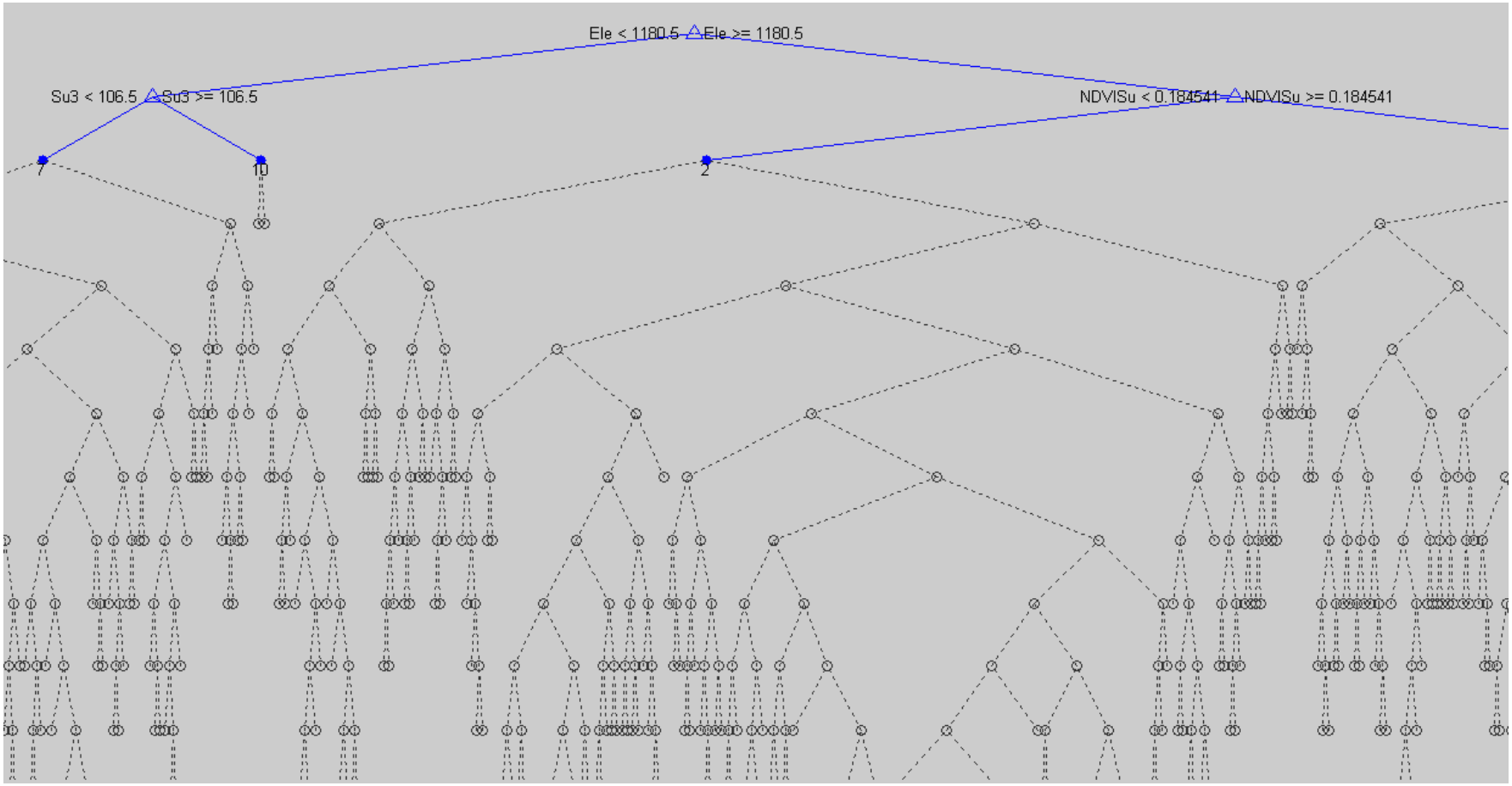
ReGap Sample Distribution



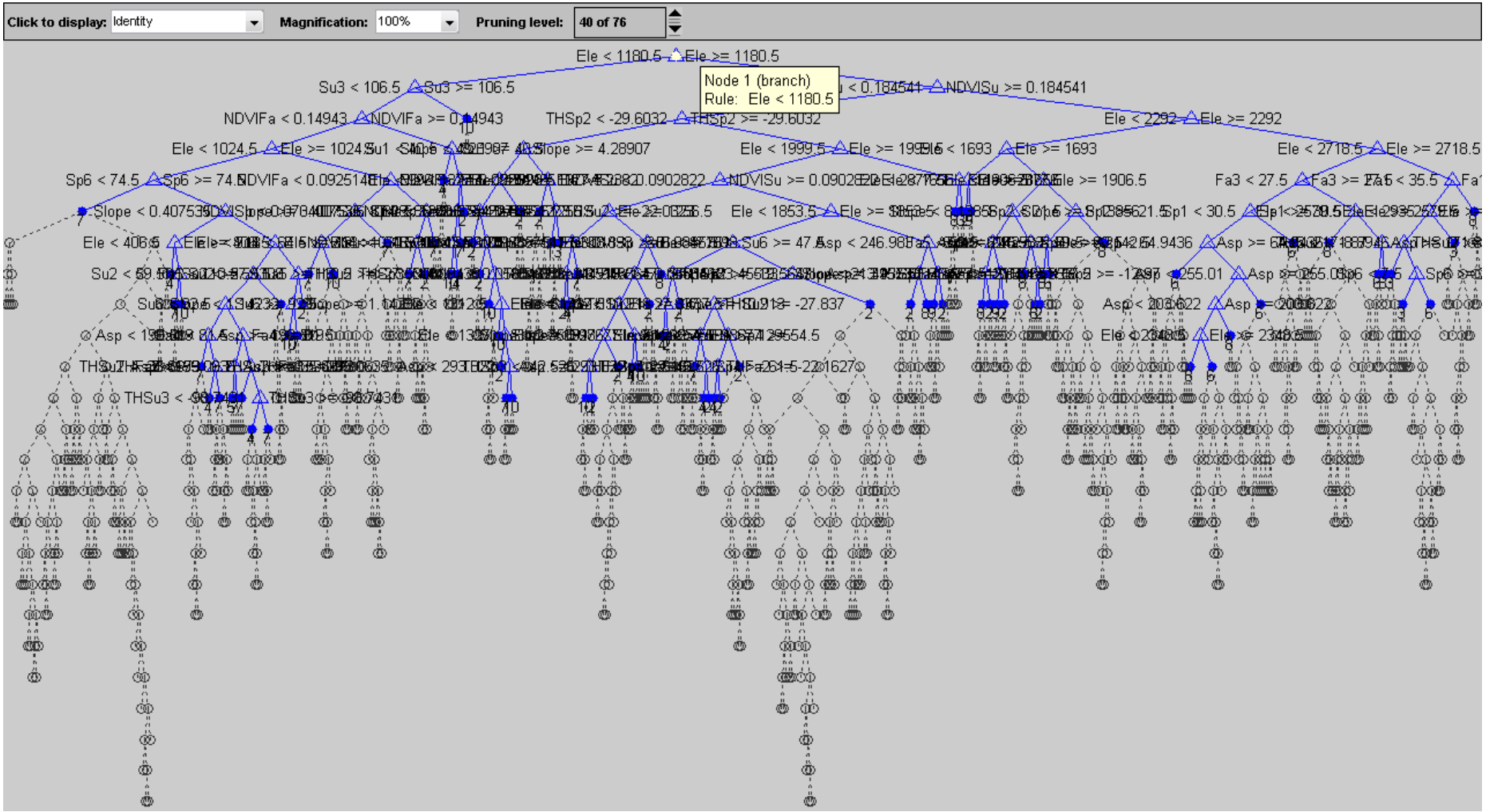
Feature Data Extraction



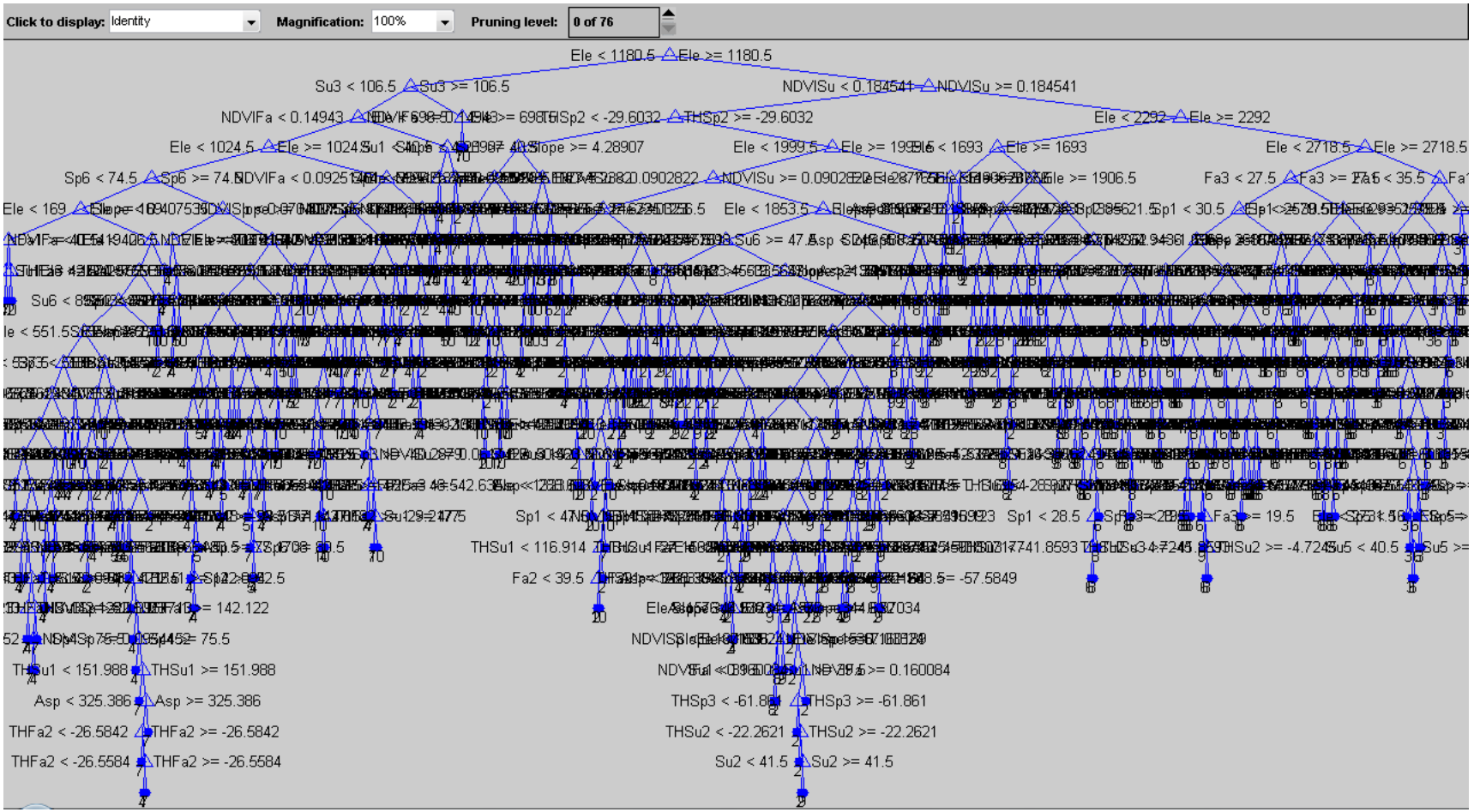
Plant a Cart Tree



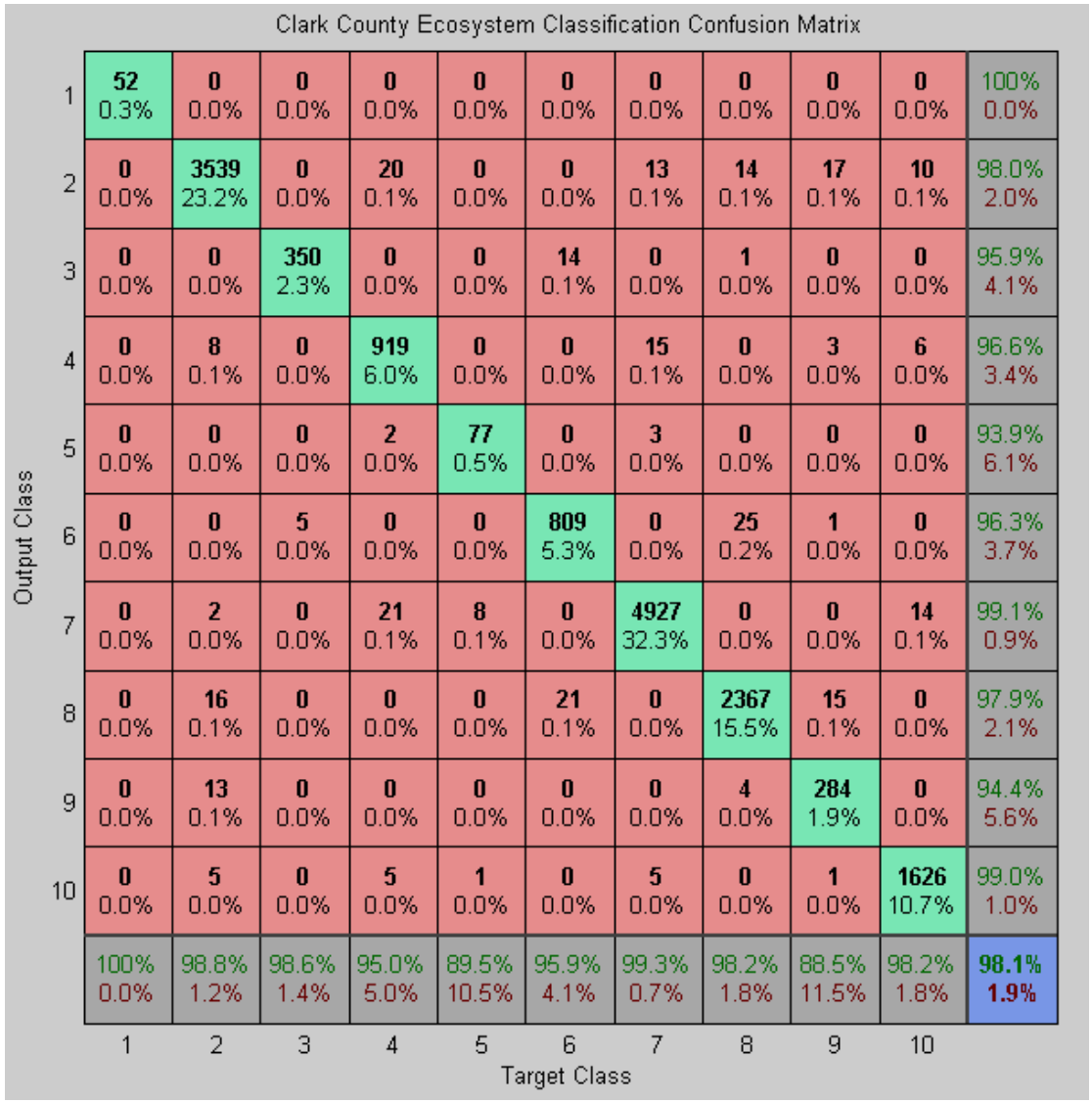
Cart Tree is Growing…



A Complete CART Tree

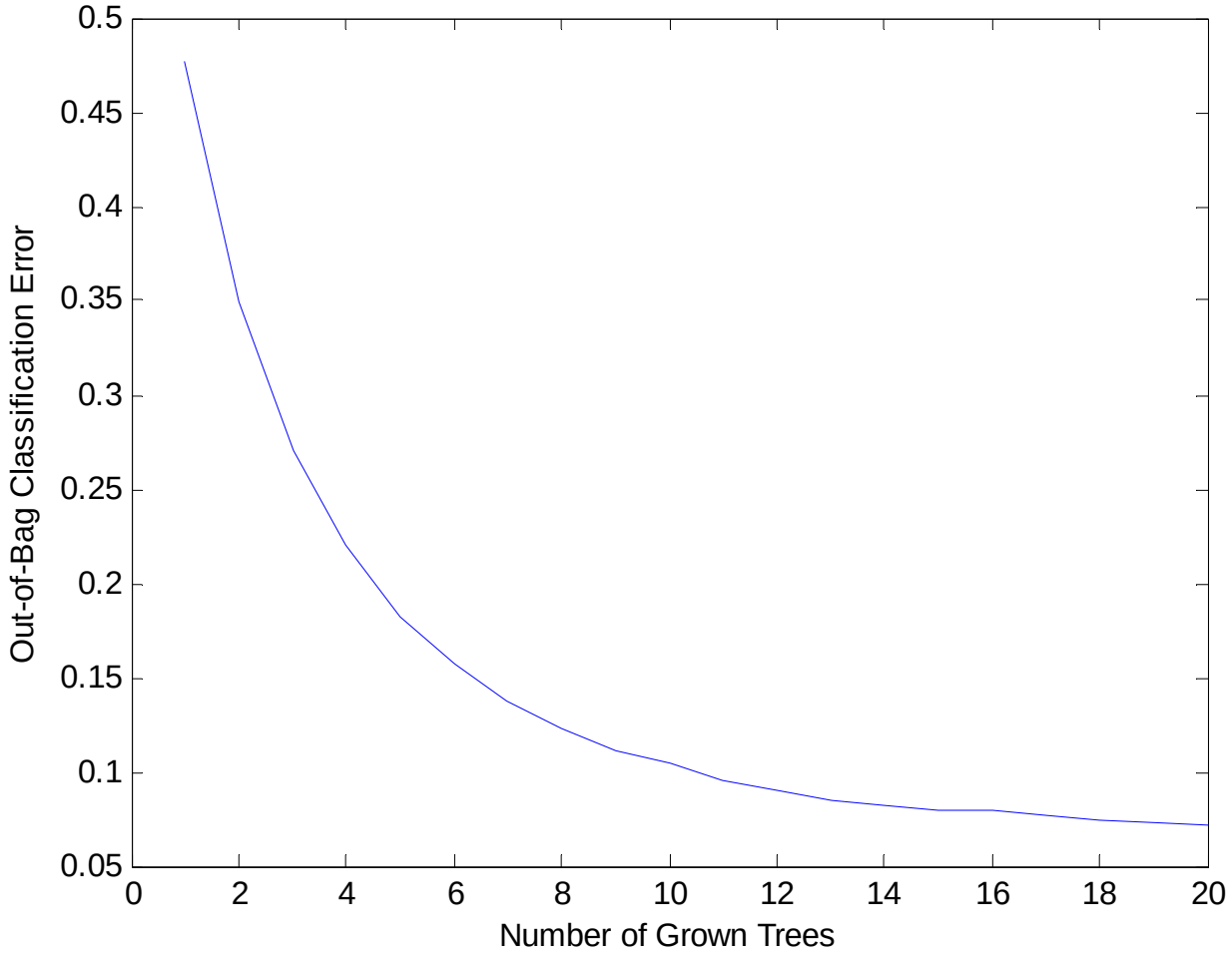


Confusiton Matrix of the Cart Tree

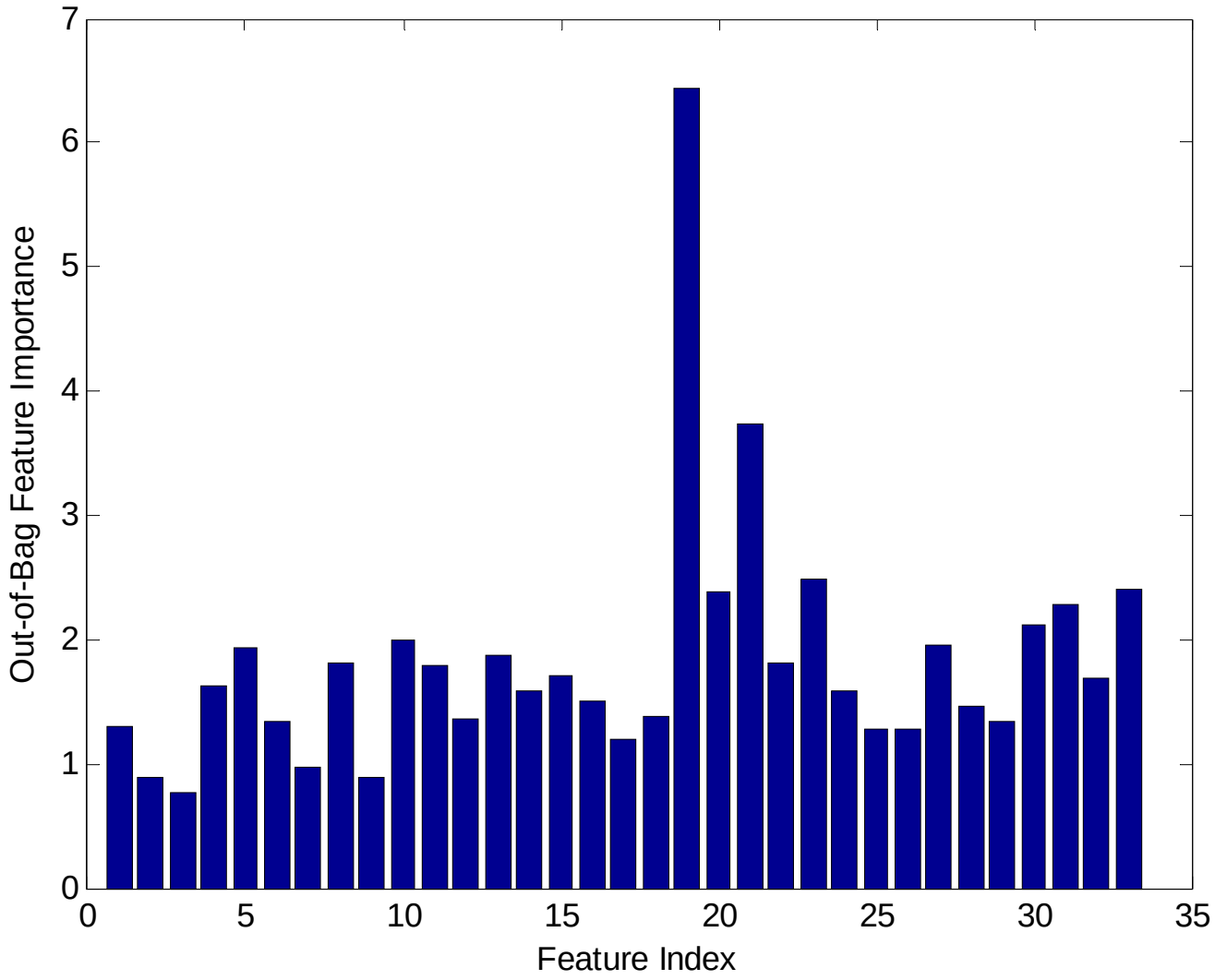


Output Class \ Target Class	1	2	3	4	5	6	7	8	9	10	
1	52 0.3%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	100% 0.0%
2	0 0.0%	3539 23.2%	0 0.0%	20 0.1%	0 0.0%	0 0.0%	13 0.1%	14 0.1%	17 0.1%	10 0.1%	98.0% 2.0%
3	0 0.0%	0 0.0%	350 2.3%	0 0.0%	0 0.0%	14 0.1%	0 0.0%	1 0.0%	0 0.0%	0 0.0%	95.9% 4.1%
4	0 0.0%	8 0.1%	0 0.0%	919 6.0%	0 0.0%	0 0.0%	15 0.1%	0 0.0%	3 0.0%	6 0.0%	96.6% 3.4%
5	0 0.0%	0 0.0%	0 0.0%	2 0.0%	77 0.5%	0 0.0%	3 0.0%	0 0.0%	0 0.0%	0 0.0%	93.9% 6.1%
6	0 0.0%	0 0.0%	5 0.0%	0 0.0%	0 0.0%	809 5.3%	0 0.0%	25 0.2%	1 0.0%	0 0.0%	96.3% 3.7%
7	0 0.0%	2 0.0%	0 0.0%	21 0.1%	8 0.1%	0 0.0%	4927 32.3%	0 0.0%	0 0.0%	14 0.1%	99.1% 0.9%
8	0 0.0%	16 0.1%	0 0.0%	0 0.0%	0 0.0%	21 0.1%	0 0.0%	2367 15.5%	15 0.1%	0 0.0%	97.9% 2.1%
9	0 0.0%	13 0.1%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	4 0.0%	284 1.9%	0 0.0%	94.4% 5.6%
10	0 0.0%	5 0.0%	0 0.0%	5 0.0%	1 0.0%	0 0.0%	5 0.0%	0 0.0%	1 0.0%	1626 10.7%	99.0% 1.0%
	100% 0.0%	98.8% 1.2%	98.6% 1.4%	95.0% 5.0%	89.5% 10.5%	95.9% 4.1%	99.3% 0.7%	98.2% 1.8%	88.5% 11.5%	98.2% 1.8%	**98.1%** **1.9%**

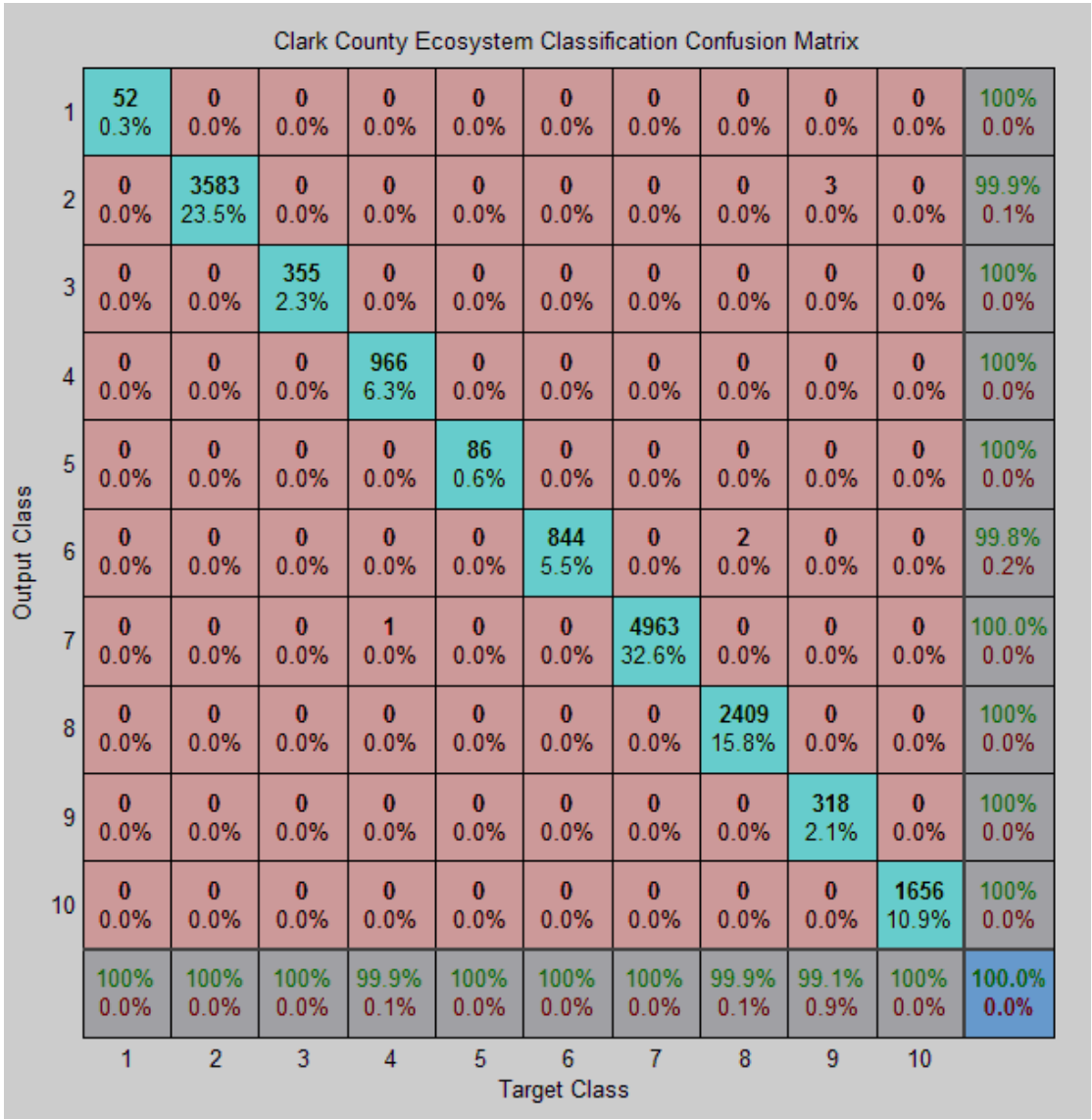
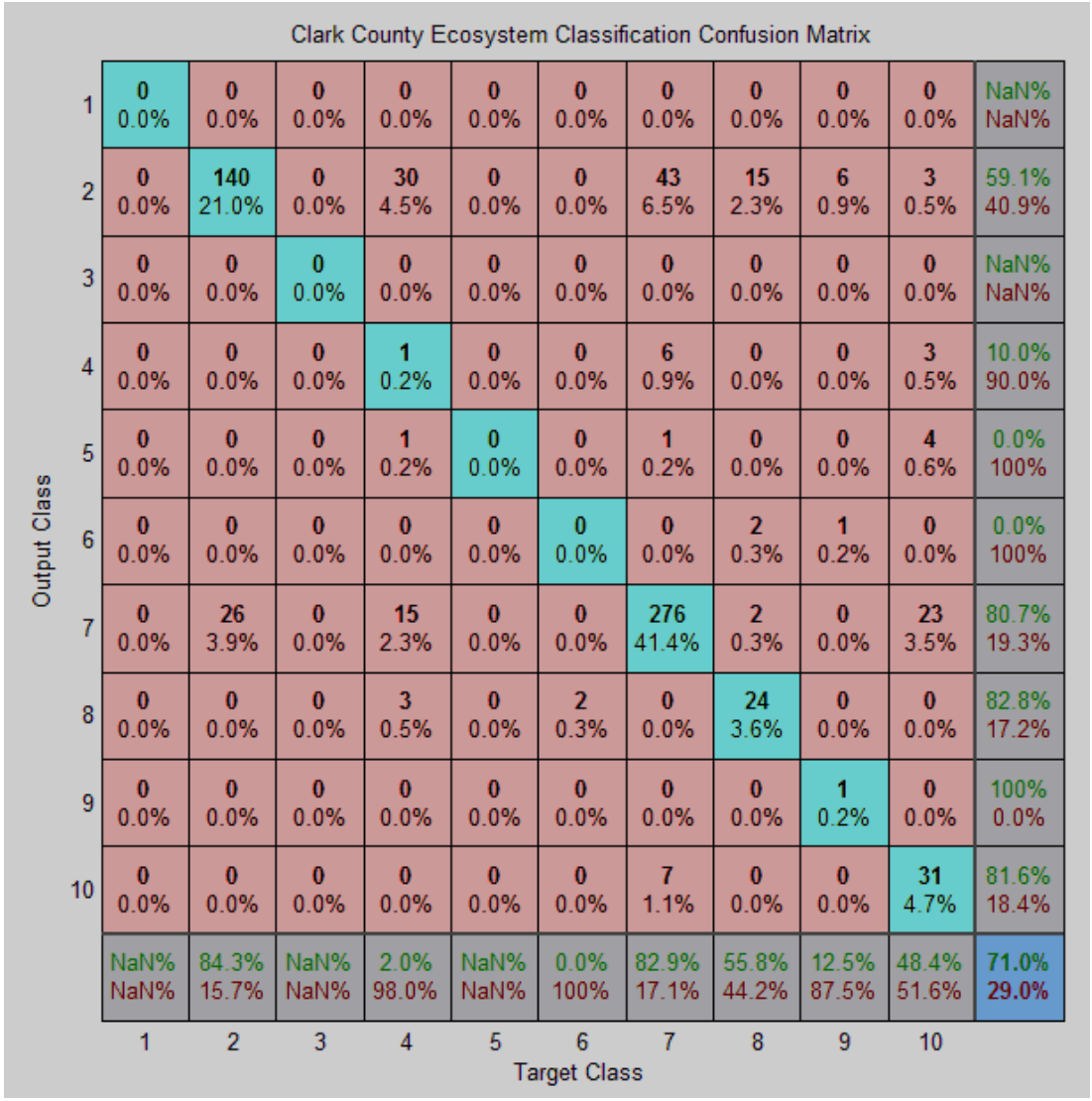
Out-of-Bag Error of Bagging Trees



Feature Importance



Confusion Matrix of the Bagging Trees



Confusion Matrix of the Bagging Trees for New Field Data