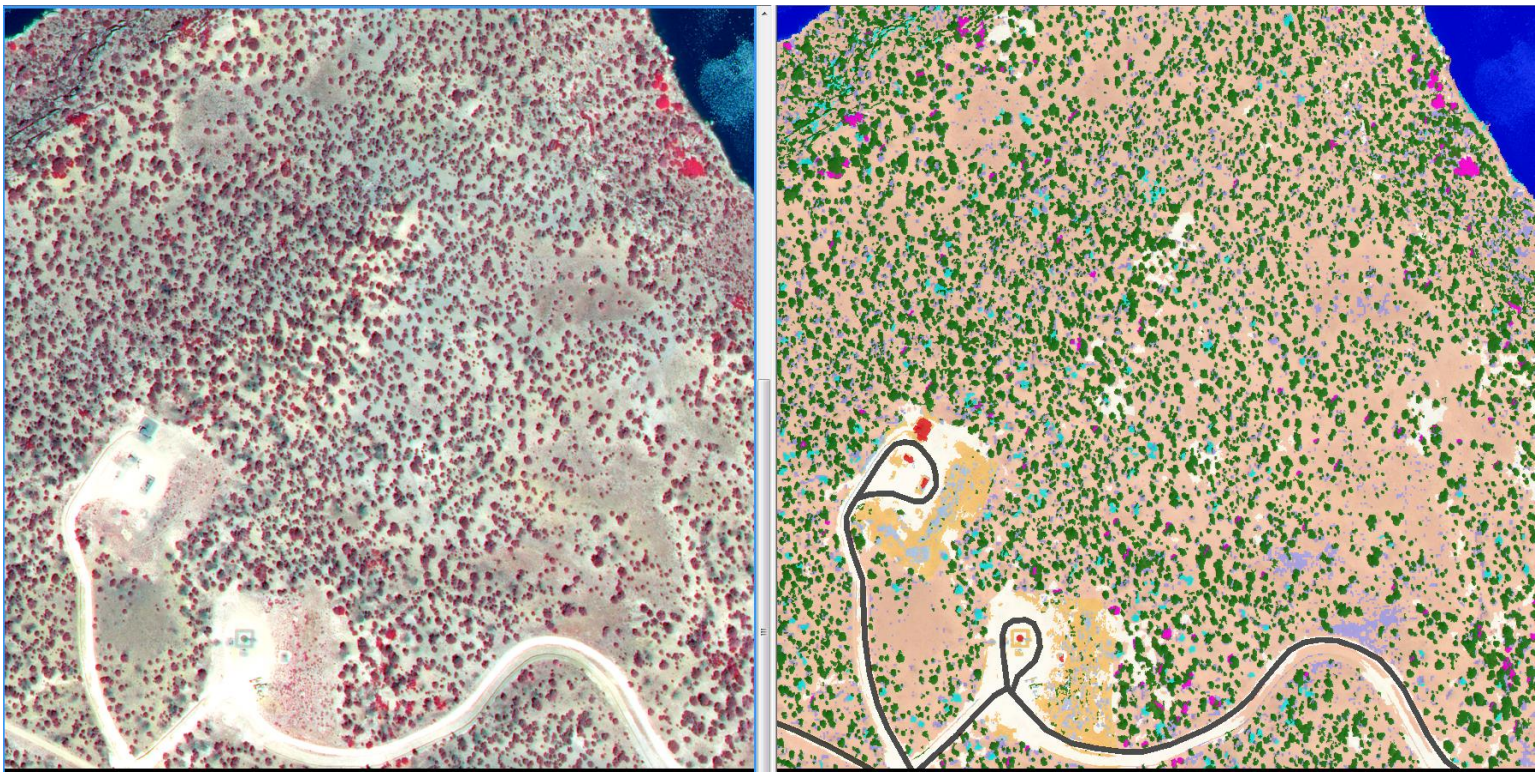

Land Cover Mapping in the BLM Rosa Landscape Area using eCognition Software and 30cm Imagery

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Contents

Introduction

Geospatial land cover classifications using satellite imagery have traditionally been created using pixel based image classification systems. With the advent of new software packages such as Definiens eCognition, an image object based classification scheme can be employed. Object oriented image analysis allows for the automated or semi-automated analysis of high resolution images. Pixel based classifiers often lead to a speckle effect as they only look at one pixel at a time without considering its spatial context. Object based classifiers avoid this problem by segmenting an image into homogenous segments before the classification is employed (Willhauck, 2000).

The goal of this project is to delineate vegetation and land cover features on Bureau of Land Management (BLM) lands in the Rosa Landscape area of New Mexico using high resolution imagery. Employing this process for the first time at New Mexico Forest and Watershed Restoration Institute (NMFWRI) was also a proof of concept for learning the software and also to create a usable GIS based land cover layer. The end results can then to be used for habitat assessment and multiple land management activities and assessments.

Study Area

The Rosa Landscape Area is located 45 miles east of Farmington, NM in northern Rio Arriba County. The study area is over 170 square miles or 111,000 acres. This area is spotted with well pads and extensive road networks to support oil and natural gas production. Because of the fragmented landscape, habitat for wildlife is a concern. Providing an updated vegetation and land cover geospatial layer is a priority for the BLM

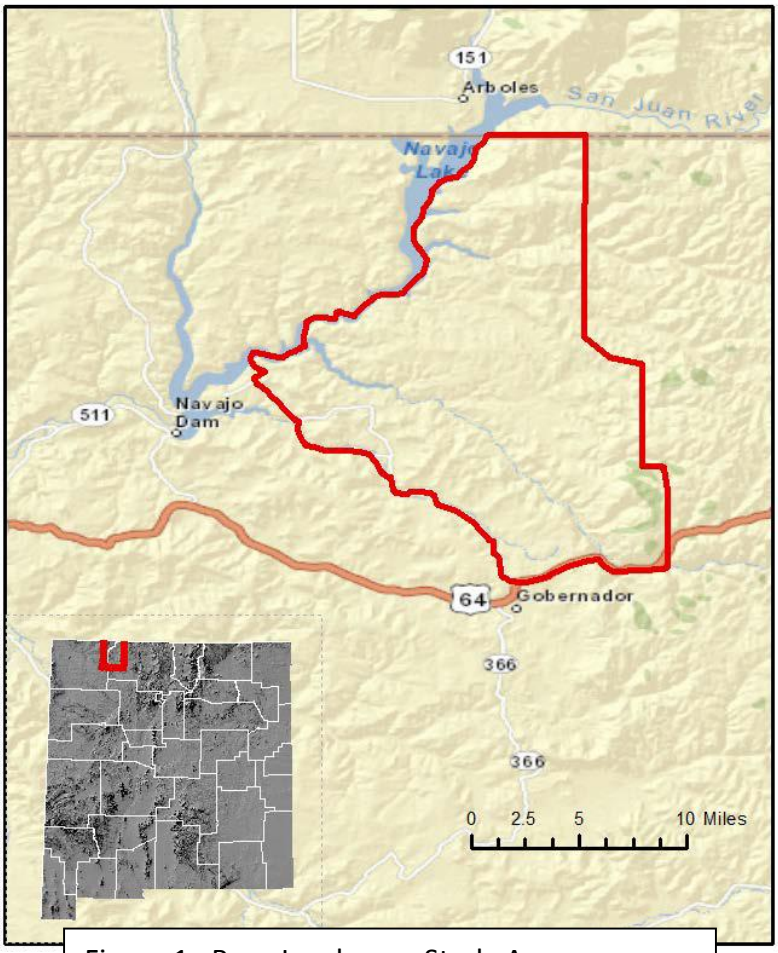

Figure 1. Rosa Landscape Study Area

Methodology

Data Preparation

Imagery was purchased from Digital Globe and we received 16 image tiles of True Color and Color Infrared Imagery. Imagery was acquired in April of 2010 with a sensor attached to an aircraft. True color imagery was collected at 30cm or 1 foot resolution. Near infrared imagery was collected at 60 cm or 2 foot resolution. The final classification was developed at 30cm resolution.

Before running the classification certain spatial layers had to be created. The Navajo Lake area is adjacent to the study area and the large water body was classified separately and then converted into a shapefile. Also since it was important to differentiate vegetation on well pad vs non-well pad areas we digitized all of the existing well pads using the 2010 imagery. We defined well pads as cleared areas surrounding the well pumps that consist of bare ground and minimal vegetation. Approximately 1,135 well pads were identified. Roads were also digitized using the 2010 in order to accurately capture the road networks located throughout the study area. All serviceable roads were digitized. All of these shapefiles; water, well pads and roads

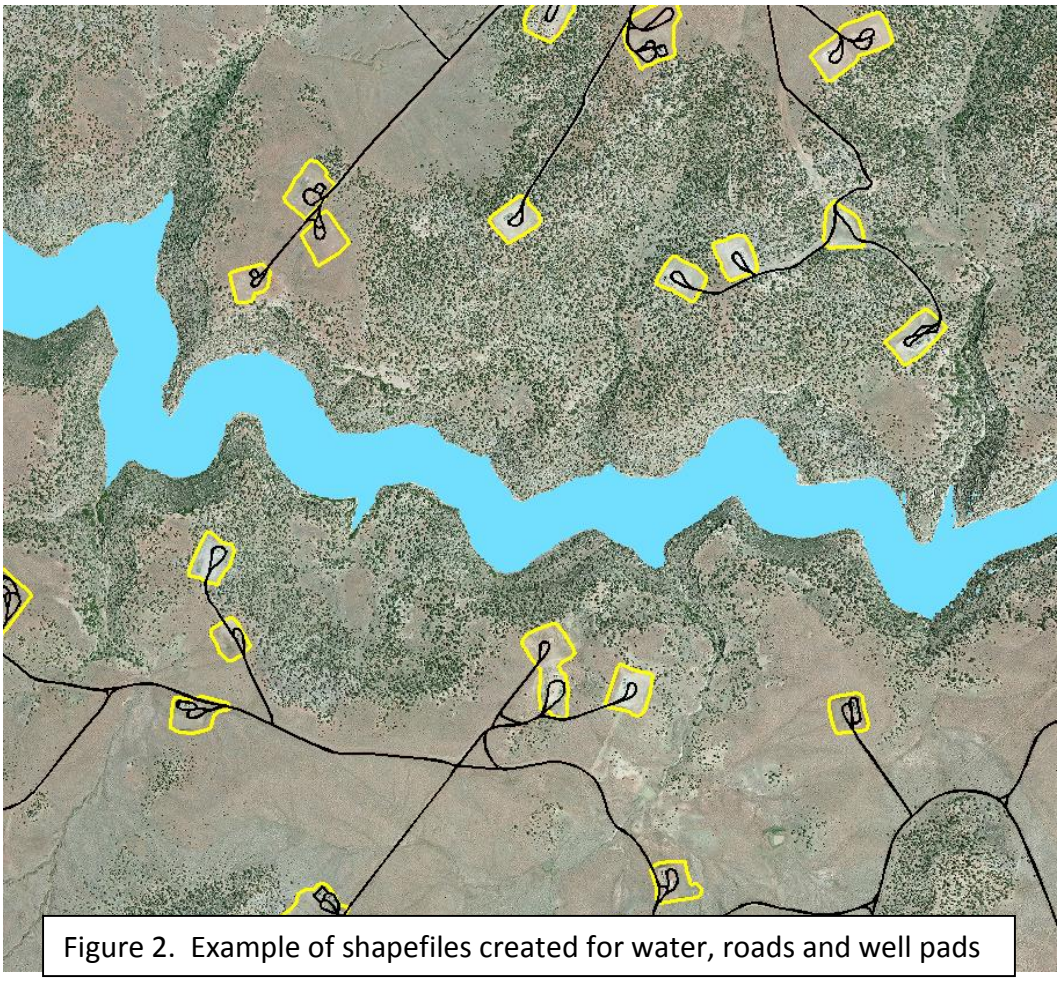

Figure 2. Example of shapefiles created for water, roads and well pads

were created before running the classification. These shapefiles were then used in eCogniton as part of the automated classification routine.

Field Work

To validate our classification and to supplement our accuracy assessment field work was carried out in the Fall of 2012. Rick McNiell, a consultant Botanist, was hired to go to specific areas and take photographs and to document the vegetation species found at each location and to identify the variety of species found throughout the study area (See Appendix A for all plant species identified in the Rosa Landscape Area). Areas were selected to represent a variety of landscape specific areas and elevations. A total of 126 sites were sampled.

eCognition- Object Oriented Image Analysis

Automatic processing of digital imagery has advanced in recent years due to software such as Definiens eCognition. eCognition software incorporates object based image analysis. The most common approach for creating these objects is with image segmentation. Image segmentation divides the image into homogenous objects. These objects are determined by scale and other input parameters that the user identifies, plus the imagery and any ancillary GIS layers.

Once image objects are created, they provide a great deal of information from which an image classification can be developed. In the example provided in Figure 3, an image object was selected representing a gamble oak tree. Gamble oak has a very high vegetative response and we are able to capture that with a value using a vegetation ratio called the Normalized Difference Vegetation Index (NDVI) that we calculated with the visible red and near infrared layers of the imagery.

In Figure 3 we identify the gable oak image object and once selected we can display all of the associated information with that object. In this case gable oak has an NDVI value of .70 and we were able create a condition in the rule set that if vegetation with a Ratio NDVI is greater than or equal to .48 then that class is gamble oak. This is how the rule set was developed by finding specific threshold for each land cover class. Since the study area covers a large area and includes 16 separate image tiles, rule sets were developed to assign classes based on properties inherent within the image objects and GIS layers. Rule sets are the processing script that eCogntion uses to automate the classification. Rule sets can be very complicated and are set to flow sequentially so that when the rule set is executed it goes through many steps before resulting in a final classification. Rule set development accounted for a large amount of time in the project as a new ruleset was developed for each separate image tile. Each separate land

cover class had specific thresholds that had to be tested and re-evaluated for each separate image tile.

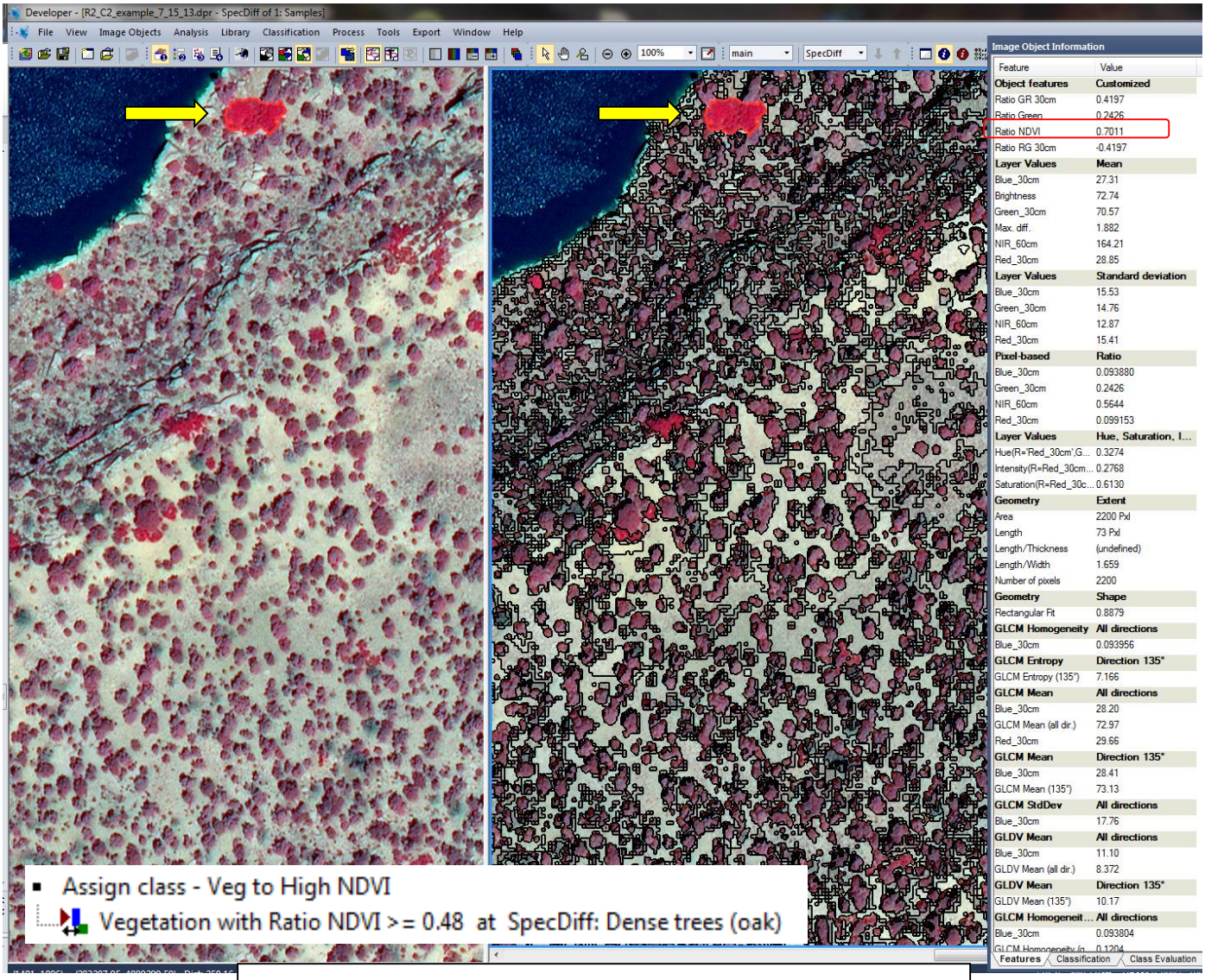

Figure 3. Image Segmentation and Image Object Information

Once a rule set was completed for an image tile it was tested and a classification was performed (see example in Figure 4). Because of the limitations found within eCognition there are only so many image segments that can be created. We were reaching something close to a million image segments within each scene and the software would crash. To solve this problem each image tile was diced into smaller scenes 1000 meters by 1000 meters. Within Definiens Developer Workstation each diced image was loaded into a workspace. By setting the work environment and specifying the location of the rule set, each diced image was classified one

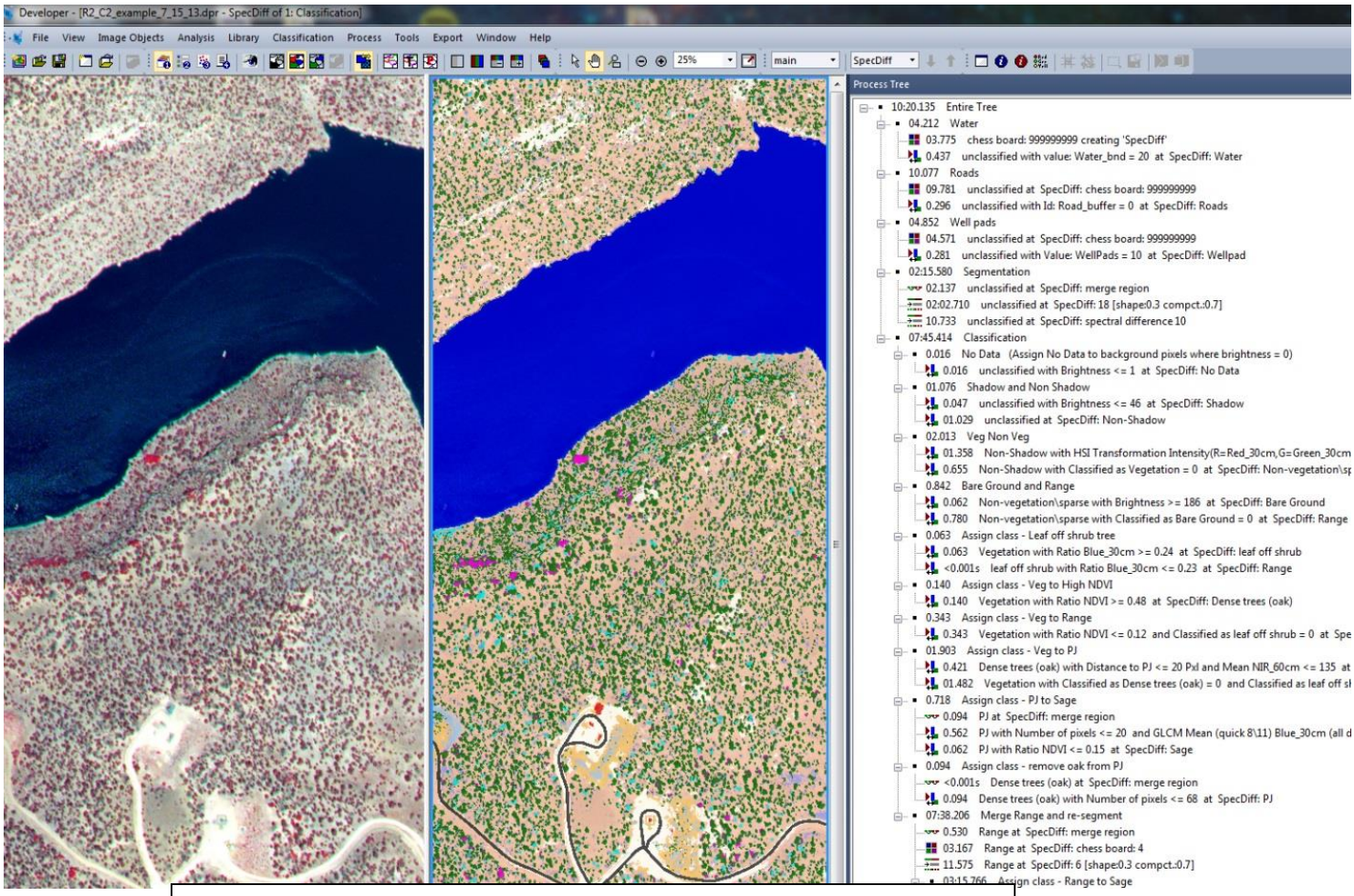

Figure 4. Rule Set Development and eCognition work environment.

after the other until they were all finished. These processes were set to run overnight as it would take anywhere between 8-26 hours to complete. In the end all of the separate classified diced images were mosaicked into one image tile. This was done for all 16 image tiles. As mentioned previously well pads were classified using the well pad shapefile to identify well pad locations. Once the well pad location was identified an image segmentation was applied and then the image objects were classified into well pad specific land cover classes. See Figure 5.

Riparian areas were also classified separately to capture the variety of plant species and allow for the classification of willow, salt cedar, cottonwood, chamisa and greasewood species. See Figure 6. Imagery was clipped using a riparian shapefile layer that was developed at NMFWRI and specific rules sets were developed. Once classified the riparian layers were mosaicked on top of the each classified image tile.

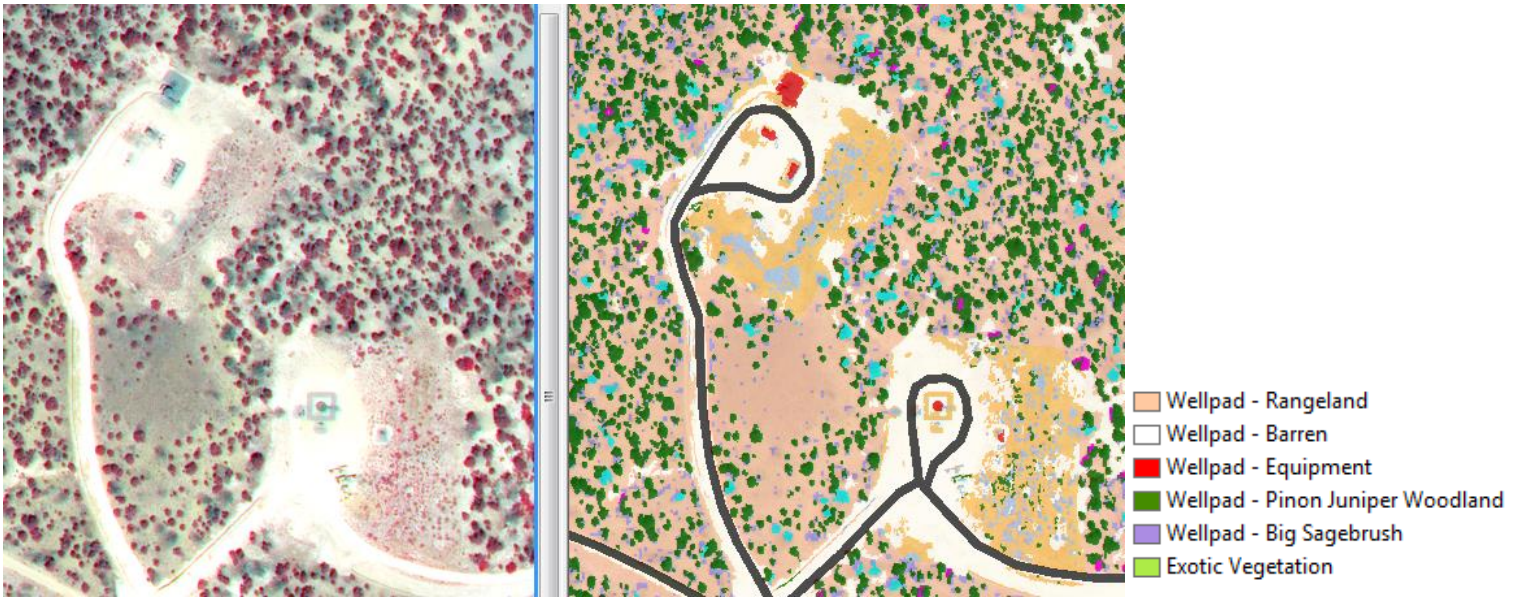

Figure 5. Well pad Classification Example

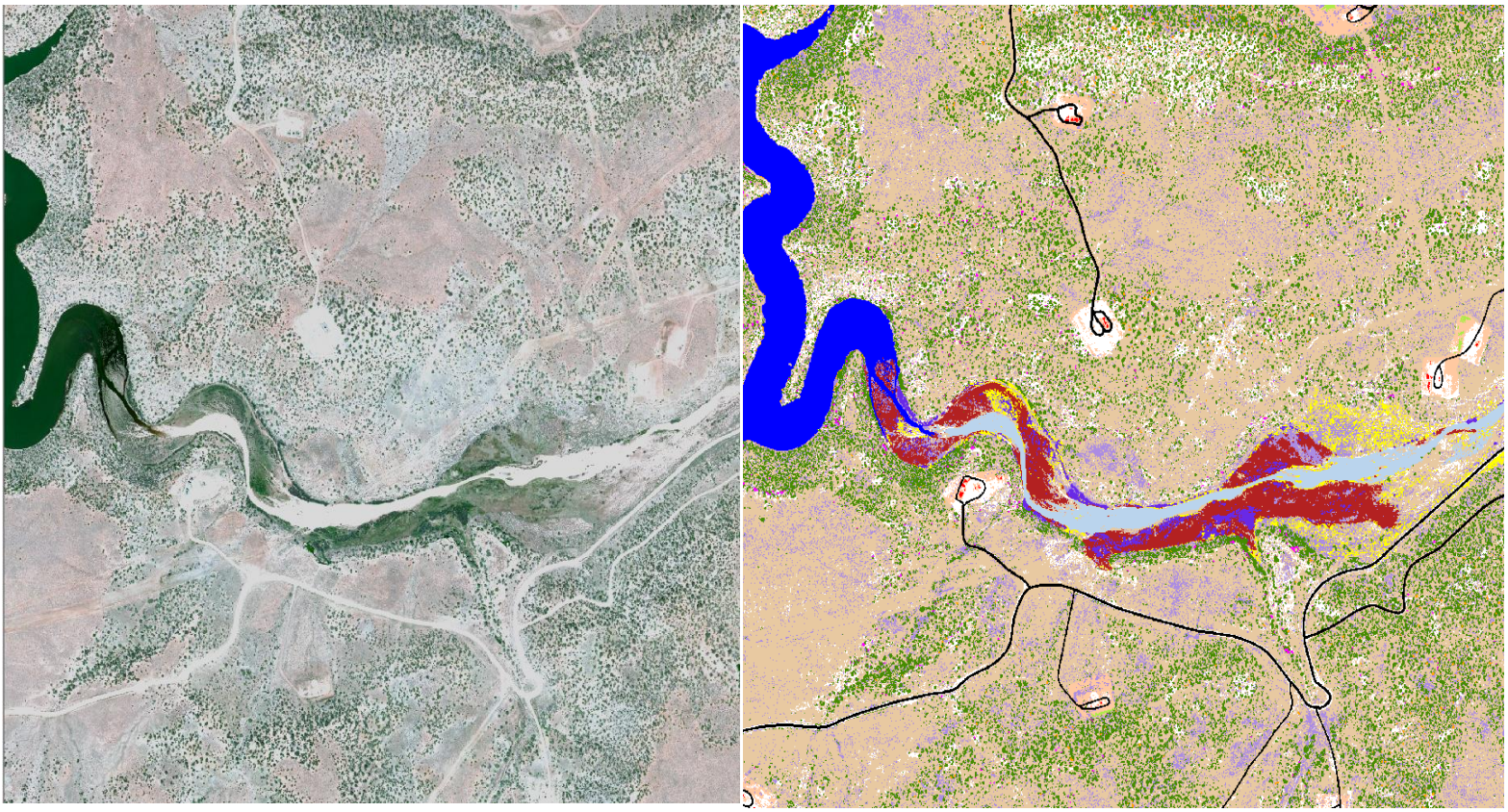

Figure 6. Riparian Areas Classification Example

Results

The final land cover classification included 21 land cover classes including Gamble Oak, Piñon-Juniper Woodlands, Dead Vegetation, Water, Barren, Sparse Vegetation and Rangeland, Dry Mixed Conifer Woodlands, Big Sagebrush Shrubland, Roads, Upland Browse, Willow, Sandy Wash, Salt Cedar, Rio Grande Cottonwood, Greasewood and Chamisa Shrublands, Wellpad Rangeland, Wellpad Barren, Wellpad Equipment, Wellpad Piñon Juniper Woodlands, Wellpad Big Sage Brush, Exotic Vegetation. Table 1 lists the class description and the acreage totals for each land cover class within the Rosa Landscape Area.

Table 1. Rosa Landscape Land Cover Classes with Acreage Totals

Class Name	Class Description	Acres
Gambel Oak	Quercus gambelii shrubland	1,293.82
Pinyon Juniper Woodlands	Twoneedle pinyon (Pinus edulis), Oneseed juniper (Juniperus monosperma) and Rocky Mountain juniper	26,990.83
Dead Vegetation	Areas of dead vegetation that have no photosynthetic activity	1,633.88
Water	Open water areas	2,407.76
Barren	Non-vegetative areas including rock	8,725.82
Sparse Vegetation and Rangeland	Low vegetative areas including grasslands	50,916.32
Dry Mixed Conifer Woodlands	Ponderosa Pine (Pinus ponderosa) and Douglans Fir (Pseudotsuga menziesii) woodlands	471.9
Big Sagebrush Shrubland	Big sagebrush (Artemisia tridentata) shrublands	13,166.48
Roads	Semi-developed roadways	1,124.87
Upland Browse	Service berry (Amelanchier utahensis) and mountain mahogony (Cercocarpus montanus)	430.38
Willow	Salix species	67.41
Sandy Wash	Intermittent stream channels	231.21
Salt Cedar	Salt Cedar (Tamarix chinensis)	57.33
Rio Grande Cottonwood	Rio Grande Cottonwood (Populus deltoides var. wislizeni)	5.95
Greasewood and Chamisa Shrubland	Greasewood (Sarcobatus vermiculatus), chamisa (Ericameria nauseosa) and some four wing saltbrush	686.68
Wellpad - Rangeland	Low vegetative areas found on well pad areas	1,556.98
Wellpad - Barren	Non vegetative areas found on well pad areas	786.04
Wellpad - Equipment	Hardware, wells, buildings, and other developed material found on well pad areas	53.52
Wellpad - Pinon Juniper Woodland	Twoneedle pinyon (Pinus edulis), Oneseed juniper (Juniperus monosperma) found on well pad areas	18.46
Wellpad - Big Sagebrush	Big sagebrush (Artemisia tridentata) found on well pad areas	109.48
Exotic Vegetation	Introduced species (weeds) often found in disturbed areas	66.12

Accuracy Assessment

In order to validate the results of our classification 292 reference points were used to develop an accuracy assessment of our land cover classification. Producer's, User's and Overall Accuracy were calculated (Table 2). The producer's accuracy refers to the probability that a certain land cover of an area on the ground is classified correctly and reflects errors of omission. The user's accuracy or errors of commission indicate the probability of a class that is

included into a category when it should have been excluded (Lunetta and Lyons, 2004). The overall accuracy for the entire classification was assessed at 78.7%.

Table 2. Accuracy Assessment for Rosa Landscape Land Cover

ACCURACY TOTALS						

Class	Reference	Classified	Number	Producers	Users	Overall
Name	Totals	Totals	Correct	Accuracy	Accuracy	
----------	----------	----------	-------	---------	-----	
No Data	0	0	0	---	---	
Gambel Oak	29	25	23	79.31%	92.00%	85.66%
Pinyon Juniper	65	75	60	92.31%	80.00%	86.16%
Dead Vegetation	27	20	20	74.07%	100.00%	87.04%
Water	10	10	10	100.00%	100.00%	100.00%
Barren	18	23	16	88.89%	69.57%	79.23%
Sparse Vegetati	36	45	31	86.11%	68.89%	77.50%
Dry Mixed Conifer	17	15	15	88.24%	100.00%	94.12%
Big Sagebrush	47	40	29	61.70%	72.50%	67.10%
Roads	0	0	0	---	---	
Upland Browse	10	5	5	50.00%	100.00%	75.00%
Willow	4	9	4	100.00%	44.44%	72.22%
Sandy Wash	0	2	0	---	---	
Salt Cedar	11	5	5	45.45%	100.00%	72.73%
Cottonwood	0	0	0	---	---	
Greasewood/Chamisa	9	7	6	66.67%	85.71%	76.19%
Wellpad - Range	0	1	0	---	---	
Wellpad - Barren	0	3	0	---	---	
Wellpad - Equip	9	6	6	66.67%	100.00%	83.34%
Wellpad -PJ	0	0	0	---	---	
Wellpad - Big Sagebrush	0	1	0	---	---	
Exotic Vegetation	0	0	0	---	---	

Totals	292	292	230			78.77%

Overall Classification Accuracy = 78.7%

Final maps, data, and metadata were delivered to BLM Farmington and BLM Albuquerque offices. Data were clipped by Township and Range extents to keep file sizes manageable. All geospatial data were provided in UTM, WGS 84 spheroid, Zone 13 projection system.

Percent Cover Calculations

The final land cover classification was derived at 1 foot or 30cm grid cells. While this provides a great amount of detail it is in some cases too much detail. For modeling and assessment purposes the 30cm land cover classes were converted to percent cover at 30meter grid cells. This was done for the following land cover classes; Big Sagebrush, Piñon-Juniper Woodlands, Gamble Oak, and Dry Mixed Conifer Woodlands. To derive percent cover, each of the 30cm grid cells were tallied in order to get a total count of each land cover class within a 30 meter vector grid lattice using a Zonal Attribute function in Erdas Imagine. The counts were then divided by one hundred to get percentages. These 30 meter vector lattices were then converted to raster, an example of the conversion process is found in Figure 7.

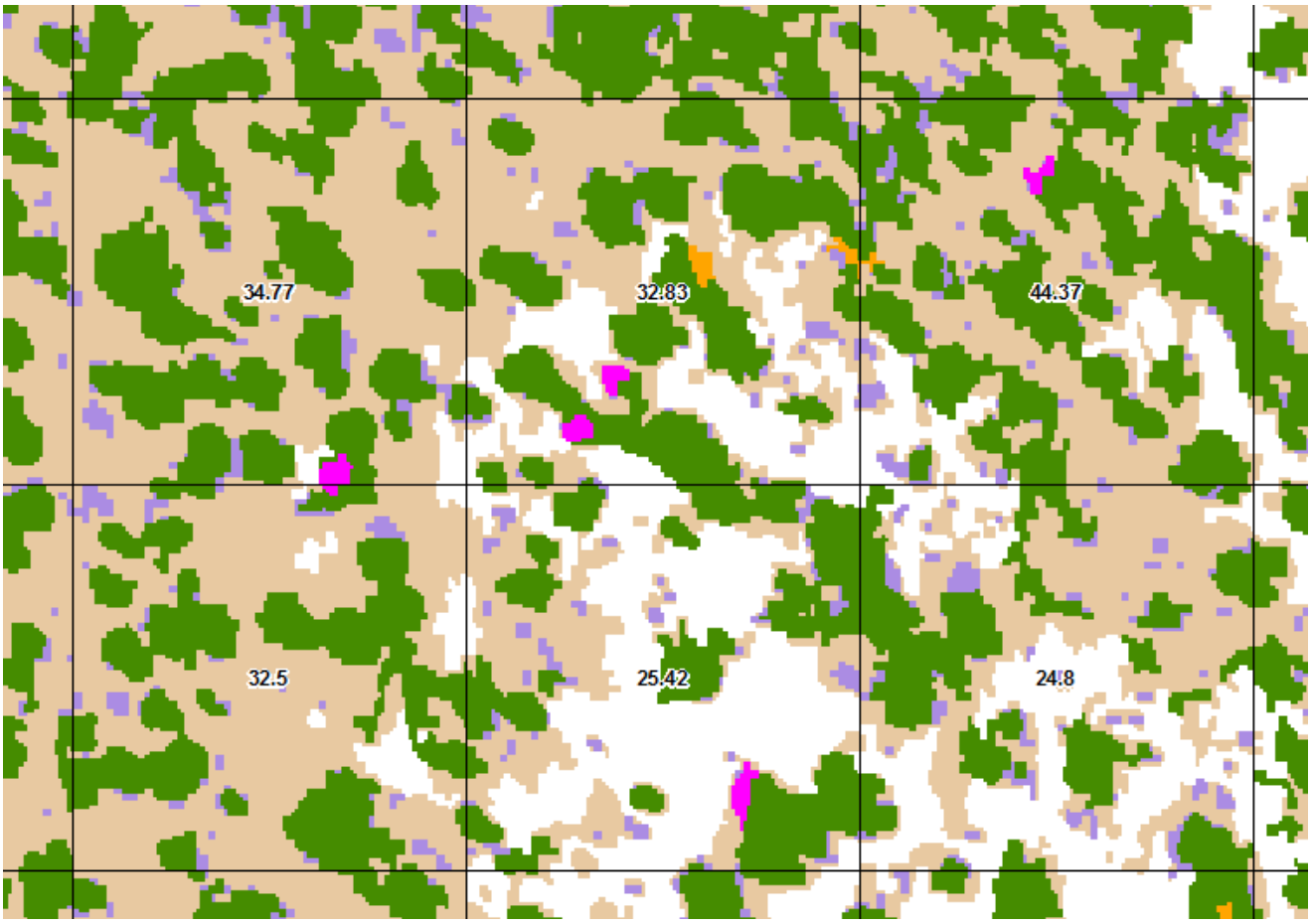

Figure 7. Estimating percent cover of Piñon-Juniper Woodlands using a 30x30 meter vector lattice.

Big Sagebrush Updates

After deriving percent cover for big sagebrush it was determined that in some cases big sagebrush was over and underestimated. Previous classification methods using eCognition software used classification thresholds for brightness, texture, and polygon size. Because brightness values also included areas of darker soils these were sometimes classified as sagebrush instead of range. John Hansen, of the BLM Farmington office, did several sagebrush transects in the Rosa in the summer of 2013. These transects were used to determine percent cover in order to improve the sagebrush classification. The texture analysis used within the eCognition did not provide useful results to classify big sagebrush. Upon further research it was determined that we could create a separate texture analysis using Erdas Imagine software. In order to create this layer a Principal Component Analysis (PCA) Image was created using only the 30cm RGB imagery. The first Principal Component image was then smoothed using a Radar Speckle Suppression Filter with a Lee Sigma algorithm. This smoothed speckle suppression image was then subtracted from the first Principal Component image. The final file created a texture layer where low values were given to smooth features and high values given to rough features. In Figure 8 you can see the resulting image where the sagebrush areas have a higher or brighter pixel value compared to Piñon-Juniper Woodlands and Rangeland areas.

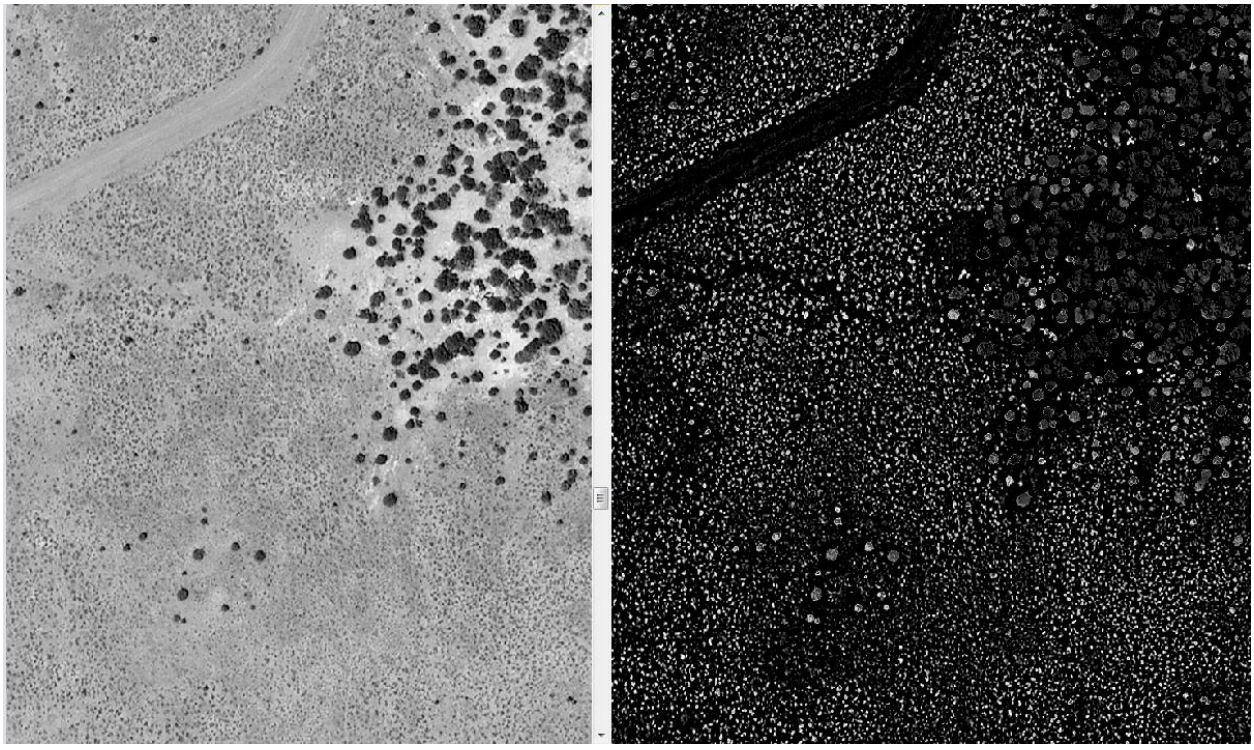

Figure 8. Left image is of first Principal Component Analysis Image, Right image is of the PCA image subtracted from speckle suppression smoothed image.

This new method is being used to update and fix the big sagebrush class in the Rosa Landscape Area. We are also applying this technique in the new Carrizo Largo study area.

Updated Accuracy Assessment with Sagebrush Updates

Incorporating the texture analysis into the image classification improved the sagebrush classification from 67% to 79%. This method increased the overall accuracy of the entire classification from 78.7% to 80.1% accuracy.

Table 3. Sagebrush Updates Accuracy Assessment for Rosa Landscape Land Cover

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy	Overall
No Data	0	0	0	---	---	
Gambel Oak	29	26	24	82.76%	92.31%	87.54%
Pinyon Juniper	65	76	60	92.31%	78.95%	85.63%
Dead Vegetation	27	20	20	74.07%	100.00%	87.04%
Water	10	10	10	100.00%	100.00%	100.00%
Barren	18	22	16	88.89%	73.72%	81.31%
Sparse Vegetati	36	50	32	88.89%	64.00%	76.45%
Dry Mixed Conifer	17	14	14	88.24%	100.00%	94.12%
Big Sagebrush	47	35	32	68.09%	91.43%	79.76%
Roads	0	0	0	---	---	
Upland Browse	10	5	5	50.00%	100.00%	75.00%
Willow	4	9	4	100.00%	44.44%	72.22%
Sandy Wash	0	2	0	---	---	
Salt Cedar	11	5	5	45.45%	100.00%	72.73%
Cottonwood	0	0	0	---	---	
Greasewood/Chamisa	9	7	6	66.67%	85.71%	76.19%
Wellpad - Range	0	1	0	---	---	
Wellpad - Barren	0	3	0	---	---	
Wellpad - Equip	9	6	6	66.67%	100.00%	83.34%
Wellpad -PJ	0	0	0	---	---	
Wellpad - Big Sagebrush	0	1	0	---	---	
Exotic Vegetation	0	0	0	---	---	
Totals	292	292	234			80.14%

Overall Classification Accuracy =	80.14%

Current Work: Carrizo Largo Area

Current work is now focused on the Carrizo Largo Study area which is located just south of the Rosa Landscape area and is over twice the extent at over 250,000 acres. We have acquired similar imagery for this study area at 30cm RGB and 60cm Near Infrared. The image acquisition date was 6-18-2010 and was also purchased from Digital Globe. Carrizo Largo imagery was delivered in 30 image tiles. Currently we have digitized all of the roads and the well pads for the Carrizo Largo area. We have developed rulesets in eCognition and are beginning to classify separate image tiles. We expect to finish the classification and provide all datasets in September of 2014.

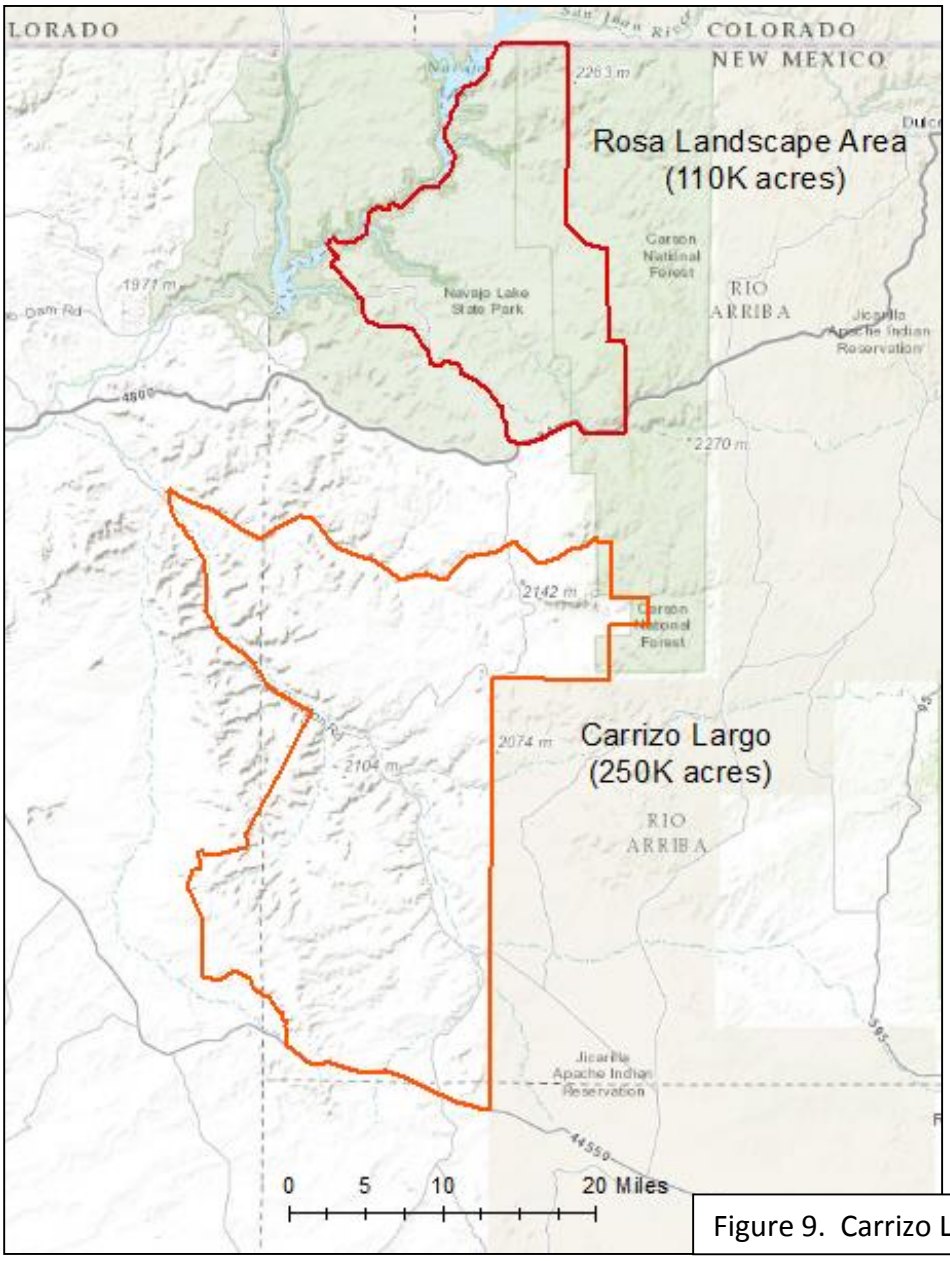

Figure 9. Carrizo Largo Study

References

Willhauck, G., "Comparison of object oriented classification techniques and standard image analysis for the use of change detection between SPOT multispectral satellite images and aerial photos," In: *International Archives of Photogrammetry and Remote Sensing Vol. XXXIII*, Supplement B3, 2000.

Benz, U.C., Hofmann, P., Willhauck, G., Lingenfelder, I. and Heynen,M., "Multi-resolution, object-oriented fuzzy analysis of remote sensing data for GIS-ready information," *ISPRS Journal of Photogrammetry & Remote Sensing*, 58, 2004.

Lunetta R., Lyon L. (Eds) , *Remote Sensing and GIS Accuracy Assessment.* CRC Press, Boca Raton, FL. 2004

Appendix A. List of Plant Species Found in the Rosa Landscape Area

SPECIES	Common Name
Achnatherum hymenoides	indian ricegrass
Agropyrum cristatum	crested wheatgrass
Amaranthus sp.	pigweed
Ambrosia sp.	ragweed
Amelanchier utahensis	sarvice berry
Arctium minus	cocklebur
Artemisia frigida	fringed sage
Artemisia ludoviciana	white sage
Artemisia tridentata	big sagebrush
Artemisia tridentata-dead	
Atriplex canescens	four winged saltbrush
Boutloua curtipendula	sideoat gramma
Boutaloua gracilis	blue gramma
Boutloua hirsuta	hairy gramma
Bromus anomolus	nodding brome
Bromus inermis	smoth brome
Bromus tectorum	cheatgrass
Carduus nutans	musk thistle
Cercocarpus montanus	mountain mahogony
Cirsium arvense	Canada thistle
Conyza canadensis	Canadian horseweed
Cuscuta sp.	dodder
Elymus elymoides	squireltail bottlebrush
Elymus spicata	blue bunch wheatgrass
Ericameria cuneata	cliff goldenbush (chamise/rabbit bitterbrush)
Erodium cicutarium	storks bill
Arctium minus	cocklebur
Grindelia squarosa	gumweed
Guterizia sarothae	snakeweed
Heterotheca villosa	hairy false goldenaster
Hilaria jamesii -> Pleurathis jamesii	galleta
Hymenopappus filifolius	fineleaf hymenopappus
Juniperus monosperma	one-seed juniper
Juniperus monosperma-dead	
Juniperus scopulorum	Rocky mountain juniper
Kochia scoparia	kochia
Koeleria macrantha	prairie Junegrass
Lycium sp.	desert thorn
Mahonia repens	creeping Oregon grape
Melilotus alba	white sweetclover
Melilotus officinalis	yellow sweetclover
Philadelphus microphyllus	little leaf mock orange
Pinus edulis	pinyon
Pinus edulis-dead	
Pinus ponderosa	ponderosa pine
Poa sp.	bluegrass
Populus acuminata	lanceleaf cottomwood
Populus deltoides var. wislizeni	Rio Grande cottonwood
Portulaca oleracea	purselane
Pseudotsuga menziesii	Douglas fir
Purshia tridentata	antelope bitterbrush
Quercus gambelii	Gambel oak
Ribes sp.	currant/gooseberry
Salix sp.	willow
Salsola tragus	Russian thistle
Sarcobatus vermiculatus	greasewood
Scirpus sp.	rush
Sphaeralcea coccinea	scarlet globe mallow
Sporobolus contractus	spike dropseed
Symphorocarpus rotunifolia	snowberry
Tamarix chinensis	salt cedar
Tamarix chinensis-dead	
Verbena bracteata	big bract verbena
Weeds assocaited with over grazed areas:EROCIC, Amaranthus sp., POROLE, SALTRA.	
Yucca baccata	bannana yucca
Bare rock	
Bare soil	
Mortis = dead	

Appendix B. Metadata

rosa_landscape_landcover_2010.img

Metadata also available as

Metadata:

Identification_Information:
Citation:
Citation_Information:
Originator: New Mexico Forest & Watershed Restoration Institute (NMFWRI)
Title: rosa_landscape_landcover_2010.img
Geospatial_Data_Presentation_Form: raster digital data
Online_Linkage: none available at this time
Publication_Information:
Publication_Place: NMHU, Las Vegas, NM
Publisher: NMFWRI
Description:
Abstract:
The New Mexico Forest and Watershed Restoration Institute was contracted with the US Department of Interior Bureau of Land Management to develop a land cover map for the BLM Rosa Landscape area in Rio Arriba County New Mexico. A land cover classification was created for this area using an object based image analysis system with Trimble eCogntion software. This raster classified image was developed using 30cm imagery obtained from Digital Globe acquired in April 2010.
Purpose:
To aid in project analysis of the BLM Rosa Landscape Area in Rio Arriba County New Mexico.
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Theme_Keyword: New Mexico Forest and Watershed Restoration Institute

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Use_Constraints:
The NMFWRI uses the most current and complete data available. Using GIS data for purposes other than those for which they were created, may yield inaccurate or misleading results. NMFWRI reserves the right to correct, update, modify, or replace GIS data without notification.
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
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Contact_Person: Patti Dappen
Contact_Position: GIS Specialist
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Publication_Date: 20110826
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Publisher: Digital Globe
Other_Citation_Details:
Advanced Ortho Aerial Program markets and cells are core DigitalGlobe products. They are pre-defined orthomosaic products packaged as a one degree cells or complete markets typically based on cities and populated areas with specific formats, naming, tiling, etc. Advanced Ortho Aerial Program products have Specifications per the Advanced Ortho Aerial Program Product Spec, and are consistent with aerially acquired and processed orthomosaics. Each Advanced Ortho Aerial Program Market is pre-defined to its own geometry and unique size, and each Advanced Ortho Aerial Program Cell has a pre-defined area of ~ 10,000 km2 for full land cover cells, and shoreline-specific rectilinear cells at the coasts.

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Originator: DigitalGlobe
Publication_Date: 20110826
Title: RGB_N36W108_2010_06_18_ISO
Geospatial_Data_Presentation_Form: remote-sensing image
Publication_Information:
Publication_Place: 1601 Dry Creek Dr. Suite 260, Longmont CO 80503
Publisher: Digital Globe
Other_Citation_Details:
Advanced Ortho Aerial Program markets and cells are core DigitalGlobe products. They are pre-defined orthomosaic products packaged as a one degree cells or complete markets typically based on cities and populated areas with specific formats, naming, tiling, etc. Advanced Ortho Aerial Program products have Specifications per the Advanced Ortho Aerial Program Product Spec, and are consistent with aerially acquired and processed orthomosaics. Each Advanced Ortho Aerial Program Market is pre-defined to its own geometry and unique size, and each Advanced Ortho Aerial Program Cell has a pre-defined area of ~ 10,000 km2 for full land cover cells, and shoreline-specific rectilinear cells at the coasts.
Online_Linkage: <http://www.digitalglobe.com/>
Type_of_Source_Media: Disk
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110826
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: RGB_N36W108_2010_06_18_ISO
Process_Step:
Process_Description:
Imagery was ordered from Digital Globe for the Rosa Landscape area that was acquired in April of 2010. A total of 16 tiles were received for the entire study area at 30cm pixel size for RGB bands and 60cm for the Near Infrared band. Image bands were combined so that the image classification was performed on four band images 1: Visible red, 2: Visible green, 3: Visible blue, 4: Near Infrared. Before running the classification well pad boundaries and roads were digitized in ArcMap with the Digital Globe imagery as the reference layer. Water bodies were classified separately in eCognition and then converted to a shapefile. These three vector layers were incorporated into the segmentation process within eCogntion at the beginning of the classification. Individual image tiles were classified separately and rule sets were developed individually for each image tile. Within eCognition image objects were created from a multi-resolution image segmentation process. These image objects were then used to develop the land cover classification. After classifying roads, well pads, and water areas the rest of the image was classified using a hierarchical approach. First the image was divided into shadow and non-shadow based on brightness values within the image. Secondly non-shadow areas were divided into Vegetation and non-vegetation areas. The non or sparse vegetation areas were then subdivided into rangeland and barren based on mean brightness values in the imagery. The vegetation areas were then divided into all the potential vegetation classes. Gambel Oak was easily identified as it has a high Normalized Difference Vegetation Index (NDVI) value. Dead vegetation was classified using mean ratio blue and low NDVI values. Piñon-Juniper areas were identified by those areas that had a higher NDVI values but were not classified as Gambel Oak. Sagebrush areas were classified using mean texture values in combination in with mean brightness. Well pad areas were re-segmented and classified separately. Similar classifications were applied to well pad

areas. The Well pad equipment class was identified using negative NDVI values. Riparian areas were classified after the initial classification. Riparian areas were subset out and re-classified using new rule sets to identify willow, salt cedar, cottonwood, sandy wash, greasewood and chamisa land cover classes. Field work was done in October of 2012 to verify the classification and to provide ground truth points for the accuracy assessment. The overall accuracy of the classification was calculated at 78%
Process_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: New Mexico Forest & Watershed Restoration Institute (NMFWRI)
Contact_Person: Patti Dappen
Contact_Position: GIS Specialist
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Attribute_Accuracy:
Attribute_Accuracy_Report:
Overall Classification Accuracy by Class: 1 Gambel Oak (85.66%), 2 Piñon Juniper Woodland (86.16%), 3 Dead Vegetation (87.04%), 4 Water (100%), 5 Barren (79.23%), 6 Sparse Vegetation and Rangeland (77.5%), 7 Dry Mixed Conifer (94.12%), 8 Big Sagebrush Shrubland (67.10%), Upland Browse: Service berry (75.00%), 11 Willow (72.22%), 13 Salt Cedar (72.73%), 15 Greasewood and Chamisa Shrubland (76.19%), 18 Wellpad Equipment (83.34) Overall Classification Accuracy 78%

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 130619
Column_Count: 101674

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Transverse Mercator
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.9996
Longitude_of_Central_Meridian: -105.0
Latitude_of_Projection_Origin: 0.0
False_Easting: 500000.0
False_Northing: 0.0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.00000000222020024164500956
Ordinate_Resolution: 0.00000000222020024164500956
Geodetic_Model:
Horizontal_Datum_Name: D WGS 1984
Ellipsoid_Name: WGS 1984
Semi-major_Axis: 6378137.0
Denominator_of_Flattening_Ratio: 298.257223563

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: rosa_landscape_landcover_2010.img.vat
Entity_Type_Definition: NMFWRI

Attribute:
Attribute_Label: Acres
Attribute_Definition: Acreage calcualted for each land cover class
Attribute_Definition_Source: NMFWRI
Attribute:
Attribute_Label: Value
Attribute_Definition: Vegetation Code
Attribute_Definition_Source: NMFWRI
Attribute:
Attribute_Label: Count
Attribute_Definition: Number of pixels
Attribute_Definition_Source: NMFWRI
Attribute:
Attribute_Label: Red
Attribute:
Attribute_Label: Green
Attribute:
Attribute_Label: Blue
Attribute:
Attribute_Label: Class_Name
Attribute:
Attribute_Label: Opacity
Attribute:
Attribute_Label: Class_Desc
Attribute:
Attribute_Label: OID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Sequential unique whole numbers that are automatically generated.
Overview_Description:
Entity_and_Attribute_Overview:
Value Name 0 No Data, 1 Gambel Oak - Quercus gambelii shrubland, 2 Piñon Juniper Woodland - Twoneedle Piñon (Pinus edulis), Oneseed juniper (Juniperus monosperma) and Rocky Mountain juniper, 3 Dead Vegetation -Areas of dead vegetation that have no photosynthetic activity, 4 Water: Open water areas, 5 Barren : Non-vegetative areas including rock, 6 Sparse Vegetation and Rangeland: Low vegetative areas including grasslands, 7 Dry Mixed Conifer Woodlands:Ponderosa Pine (Pinus ponderosa) and Douglas Fir (Pseudotsuga menziesii) woodlands, 8 Big Sagebrush Shrubland (Artemisia tridentata), 9 Roads : Semi-developed roadways, 10 Upland Browse: Service berry (Amelanchier utahensis) and mountain mahogony (Cercocarpus montanus), 11 Willow (Salix species), 12 Sandy Wash : Intermittent stream channel, 13 Salt Cedar (Tamarix chinensis), 14 Rio Grande Cottonwood (Populus deltoides var. wislizeni), 15 Greasewood and Chamisa Shrubland (Sarcobatus vermiculatus), (Ericameria nauseosa), 16 Wellpad Rangeland :Low vegetative areas found on well pad areas, 17 Wellpad Barren : Non vegetative areas found on well pad areas, 18 Wellpad Equipment: Hardware, wells, buildings, and other developed material found on well pad areas, 19 Wellpad Piñon Juniper Woodland: Twoneedle Piñon (Pinus edulis), Oneseed juniper (Juniperus monosperma) found on well pad areas, 20 Wellpad Big Sagebrush (Artemisia tridentata) found on well pad areas, 21 Exotic Vegetation Introduced species (weeds) often found in disturbed areas
Entity_and_Attribute_Detail_Citation: NMFWRI

Distribution_Information:
Resource_Description: Distribution is at the discretion of the BLM.
Distribution_Liability: See access and use constraints information.

Metadata_Reference_Information:

Metadata_Date: 20130116
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: New Mexico Forest & Watershed Restoration Institute (NMFWRI)
Contact_Person: Patti Dappen
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Metadata_Standard_Name: FGDC Content Standard for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time

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