

Change Detection Using 75-Year Aerial Photo and Satellite Data Sets, Inexpensive Means to Obtain 6 cm Resolution Data, and Developing Opportunities for Community-Oriented Remote Sensing through Photography

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USDA-ARS-Jornada Experimental Range, Las Cruces, NM

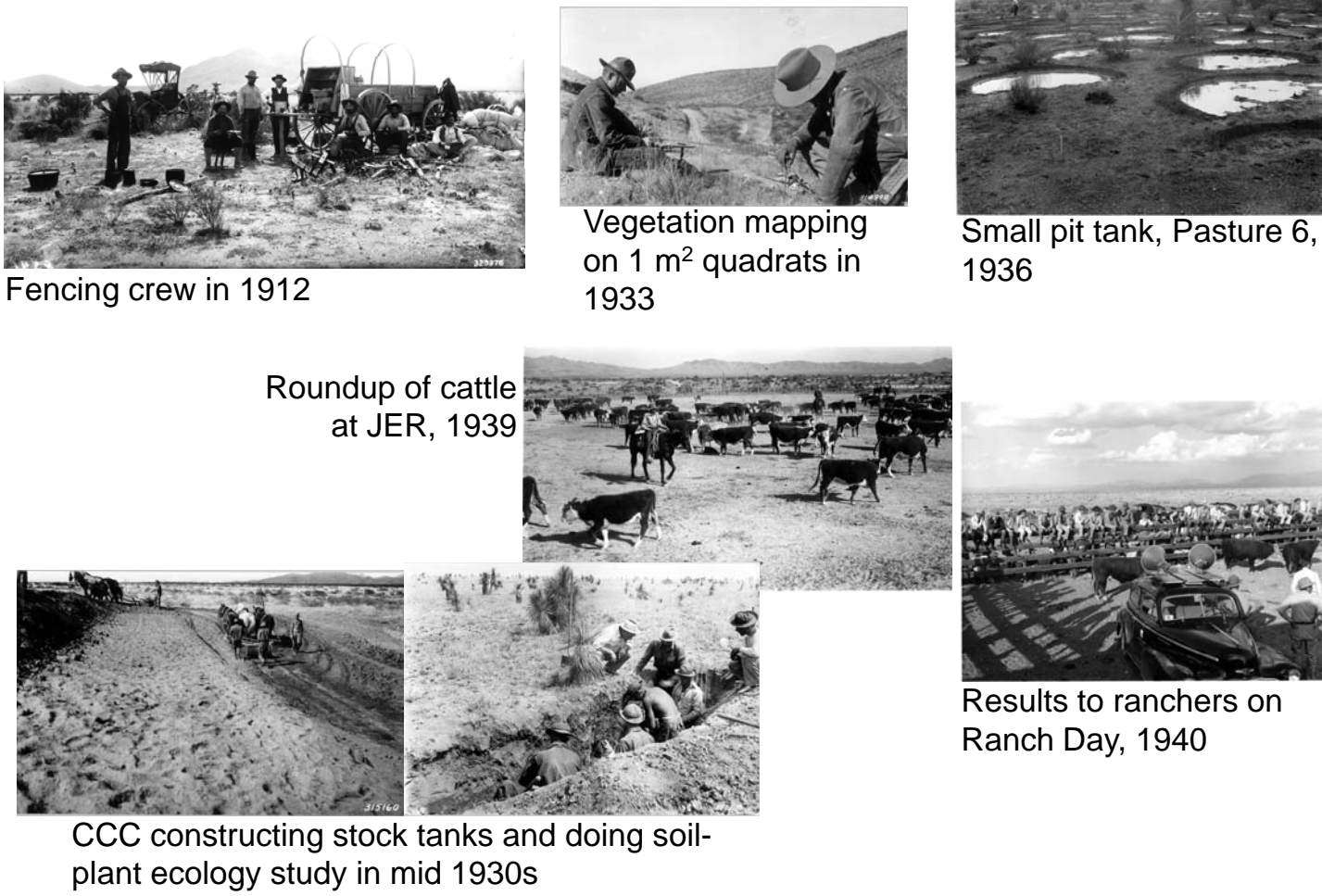
INTRODUCTION

Location of the Jornada Experimental Range (JER)

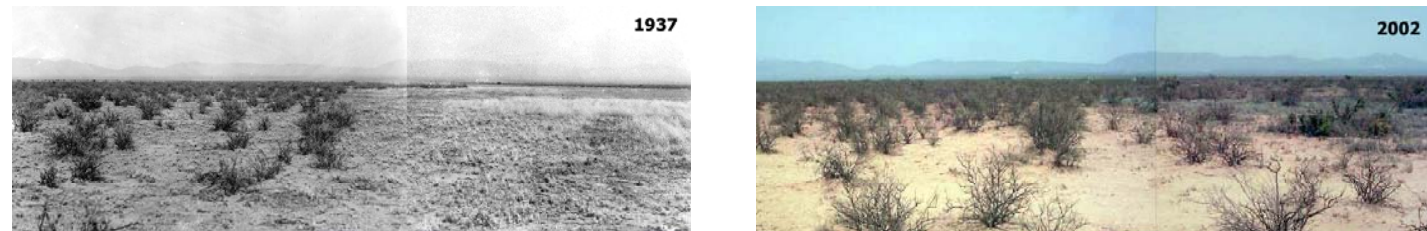
Size: 783 km²
 Established: 1912
 Ecological Region: desert grass/shrubland
 Annual Precipitation: 9.65 inches (245.1 mm)
 Website: <http://usda-ars.nmsu.edu>

HISTORIC GROUND BASED PHOTOGRAPHY

Historic ground-based photography started even prior to 1912. The earliest photos were sent to the US Forest Service in Washington, DC. The most complete collection was digitized (3148 photos) by the NMSU Library and can be accessed at <http://archphotos.nmsu.edu/keyword.cfm>. Ground photography has been valuable for documentation of research and ranch life.

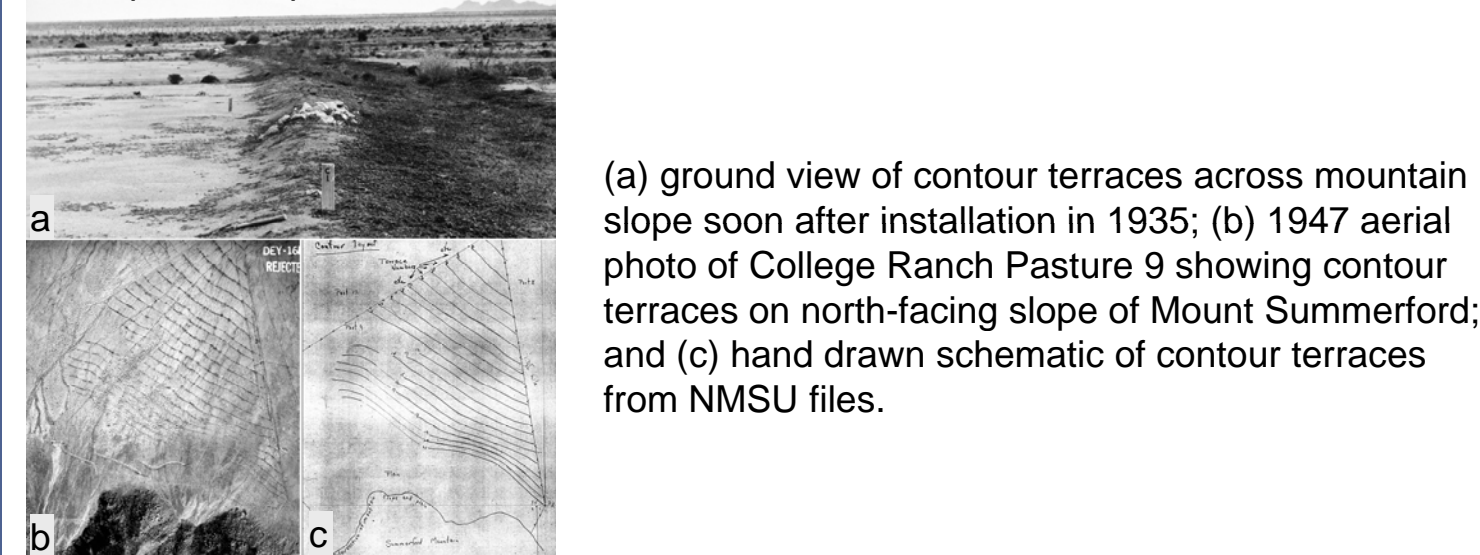


When properly documented, ground photography can be used as a part of rephotography studies, such as effectiveness of shrub removal and rates of re-invasion.



Rephotography of a tarbush grubbing site in Pasture 6 of the Jornada Experimental Range. Left photo was taken on April 22, 1937, and the right photo was taken at the same location on June 25, 2002.

Complementary use of historic ground photos, historic file project sketches, and historic aerial photos is possible.



HISTORIC AERIAL PHOTOGRAPHY

Aerial photography was begun over JER in 1936 as part of a program run by the USDA to improve farm income following the Great Depression. The Soil Conservation Service and Agricultural Stabilization and Conservation Service arranged repetitive aerial photography to assess compliance by farmers to reduce acreage under cultivation and to transition to more soil-conserving crops. Fortunately, rangelands were also included in the flights and numerous other Federal agencies and their contractors were involved across the U.S.

Here is an example of black/white, color, and color infrared images over the JER. Over 5700 aerial photographs have been acquired over JER.

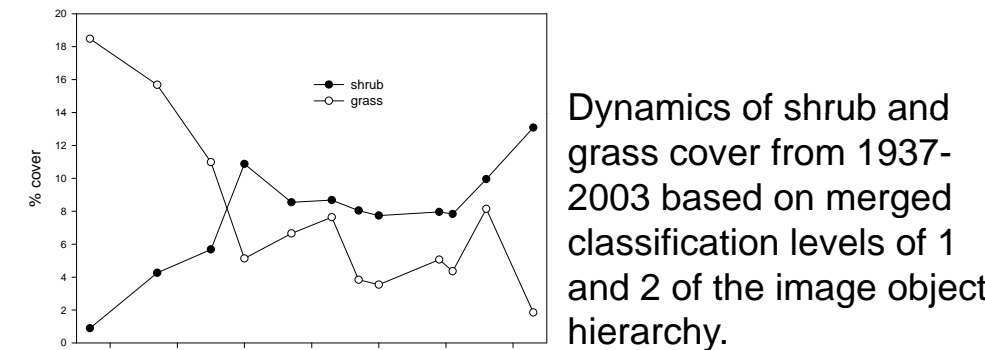
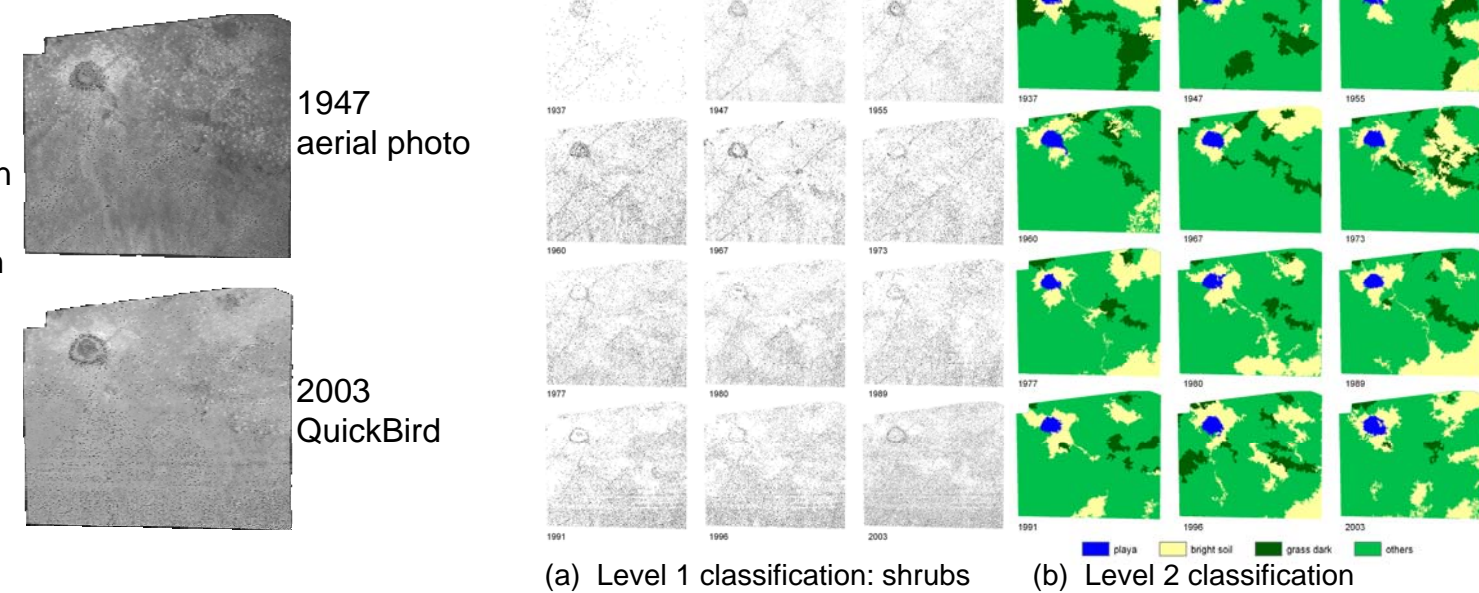


The historic aerial photography can be employed to address issues like **vegetation change**, e.g. shrub invasion into grasslands in the Southwest U.S.

1937-2003 aerial photos (or satellite data) used as basic data set for analysis of shrub invasion.

Year	Type	Resolution (m)
1937	Pan	0.61
1947	Pan	0.23
1955	Pan	0.24
1960	Pan	0.43
1967	Pan	0.46
1973	Pan	0.78
1977	CIR	0.42
1980	Color	0.68
1989	Color	0.52
1991	CIR	0.59
1996	CIR	0.86
2003*	Pan	0.60

- Resampled to 86 cm common resolution
- Smoothed with 3x3 lowpass filter



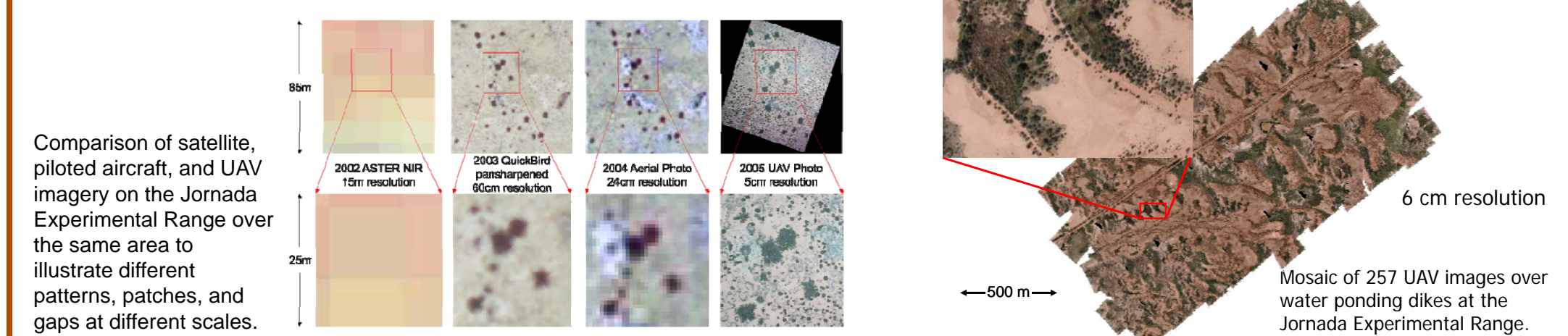
(a) Shrub cover change 1937-2003 based on results from object-based classification, level 1, and (b) changes in land cover classes for same period subtracting out the classification of shrubs.

UNMANNED AERIAL VEHICLES

Unmanned aerial vehicles (UAVs) are a recent development at JER. Even using aerial photos with about 1 m spatial resolution, you can't address some rangeland issues, such as, monitoring of rangeland health. We were told that the spatial resolution had to improve greatly to be useful for rangeland health. Our solution was to obtain aerial photos using an unmanned aerial vehicle (UAV) flying at about 215 m altitude and obtaining photos with about 5-6 cm spatial resolution.

A complete MLB Bat-3 system is in use at the Jornada Experimental Range - Our major objective is to apply hyperspatial UAV data to rangeland management in the western US. Our spatial resolution is 5 cm taken from flights at 210 m altitude. We started working with our first true UAV in August 2006.

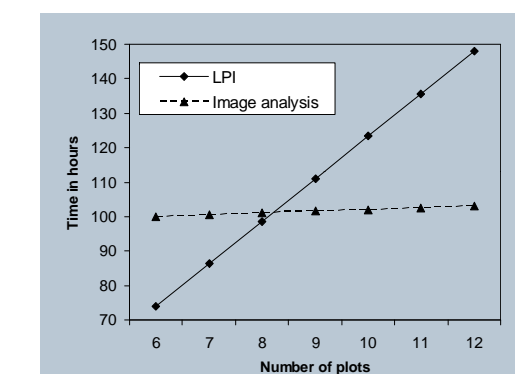
- Fully autonomous, GPS-guided UAS
- 1.8 m wingspan, 10 kg weight
- Flight duration: 2-5 hours
- Canon SD900 10 mp
- 75% forward, 40% sidelap
- Data file: X,Y,Z, roll, pitch, heading



We have compared our UAV results with the conventional approaches to obtaining data for rangeland health determinations. Particularly, we compare our determinations of vegetation pattern and type, percent bare soil, and gaps between vegetation with those obtained with conventional methods using line-point intercept (LPI) and gap intercept methods.



The UAV approach saves time (and money) after eight 50 x 50 m plots are exceeded with both methods.



The Jornada UAV team is responsible for our recognition as being one of the leaders in civil UAV applications.



8-frame Jornada UAV landing sequence

PUBLIC INVOLVEMENT



Creosote

Involvement by the public through photography is a very real possibility. We have been working in two areas where this is becoming evident. One is the remote sensing of phenology using various remote sensing platforms from UAVs to satellites. Close up ground photography is necessary to evaluate the various plant phases that might be seen with remote sensing.

A second area is remote sensing of snow covered area with satellites. Because of obscuring tree cover, the snow/no snow beneath the forest canopy needs to be answered. School field trips or public recreational trips could be the mechanism by which hand held photography could answer the question that would assist in satellite snow mapping methods, is there snow under the trees?



Rio Hondo basin, NM

CONCLUSIONS

Historic photography is valuable for establishing long-term datasets to be used in evaluating changes in natural resources. Aerial digital photography is very valuable today, including the rapidly developing field of the use of UAVs in civil applications. Hand-held photography by the community can be used as a form of ground truth for remote sensing of phenology or snow covered area.