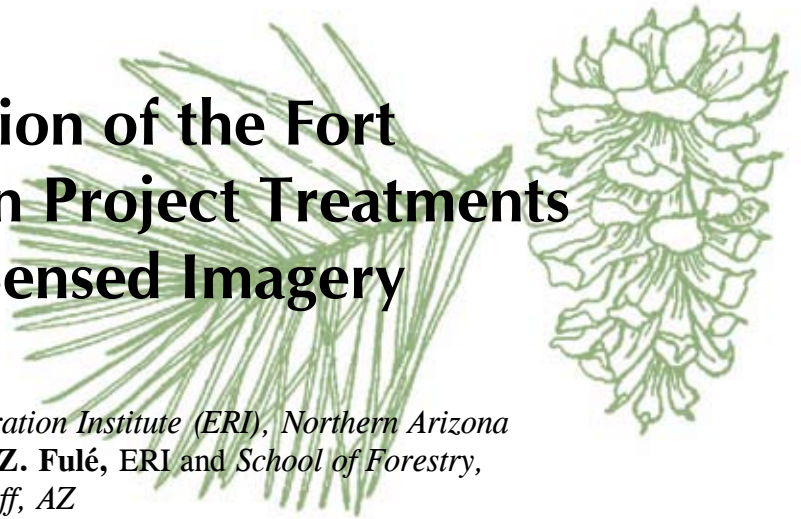


A Visual Progression of the Fort Valley Restoration Project Treatments Using Remotely Sensed Imagery



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Abstract—The landscape surrounding the Fort Valley Experimental Forest in northern Arizona has changed dramatically in the past decade due to the Fort Valley Restoration Project, a collaboration between the Greater Flagstaff Forest Partnership, Coconino National Forest, and Rocky Mountain Research Station. Severe wildfires in 1996 sparked community concern to start restoration treatments in the Fort Valley area in 1997 with various thinning prescriptions. Thinned areas have had both pile and broadcast burns. This area was chosen because of the high tree density, threat of wildfire moving upslope onto the San Francisco Peaks, to preserve recreation values, and to protect Mexican spotted owl habitat. The close proximity of the site to Flagstaff also makes it an easily accessible forest restoration demonstration site. Landsat Thematic Mapper imagery and Enhanced Thematic Mapper imagery along with ground photography, with dates ranging from 1996 through 2007, are used to display the progression of the restoration treatments. The modern landscape is a mix of areas thinned to emulate historical conditions, intermediate thinnings, and dense patches of residual forest and habitat corridors.

Introduction

Forest conditions have dramatically changed in the American Southwest since the late 1800s. The Flagstaff area, surrounded by dense ponderosa pine forests, is no exception. The interface of Flagstaff with the surrounding forested areas is known as the Flagstaff Urban Wildland Interface or FUWI. This area is a slightly greater than 100,000 acres. Decades of fire suppression and livestock grazing have resulted in increased tree densities and have led to a shift from frequent low-intensity surface fires to high-intensity crown fires (Covington and Moore 1994). During this same period, fire size has dramatically increased. Drought and climate change are other contributing factors to changing forest conditions and have been

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linked to greater wildfire activity (Veblin et al. 2000). The Flagstaff region has been under drought conditions for over a decade and, during this period, has experienced the largest recorded fires. The 1996 Horseshoe and Hochderffer fires, located northwest of Flagstaff, burned over a combined 25,000 acres in mostly ponderosa pine. The Pumpkin fire, in 2000, burned over nearly 15,000 acres of ponderosa pine and mixed-conifer forest on Kendrick Peak.

The 1996 fires caught the attention of Flagstaff citizens, forest managers, and researchers. Concerns over fires burning within the FUWI prompted a collaboration of local environmental, governmental, and business groups to address the problem. The resulting collaboration, known as the Greater Flagstaff Forest Partnership, developed a set of goals to guide their efforts. The goals, as stated in the Fort Valley Ecosystem Restoration Project (2000), are as follows: 1) to demonstrate new forest management approaches to improve and restore forest health; 2) develop and demonstrate forest restoration approaches that are environmentally sound, economically sustainable, and socially acceptable; 3) involve diverse interests and viewpoints and reach consensus on the restoration approaches; and 4) monitor and document the ecological, social, and economic impacts.

Restoration treatments were aimed at emulating historical forest conditions prior to Euro-American settlement (Covington and Moore 1994, Fulé et al. 1997, Allen et al. 2002). At Fort Valley, these treatments consisted of burning only, thinning only, or a combination of thinning and burning (Fulé et al. 2001, Abella et al. 2006).

Methods

Study Area

The area chosen for the first restoration treatments was the Fort Valley unit (Figure 1). This area is approximately five miles north of Flagstaff and encompasses all of Fort Valley to the west and extends to Schultz Creek to the east. The northeast boundary is Freidlein Prairie Road and the northwest boundary is roughly the pipeline just north of Fort Valley. The southwest boundary closely follows the Fort Valley area boundary while the southeast boundary is approximately one mile north of the Cheshire neighborhood. The unit is slightly greater than 9000 acres.

The treatment area, with the exception of Fort Valley, is densely forested (Figure 2). Ponderosa pine is the dominant tree species throughout the area but Gambel oak, Douglas-fir, and white fir are also present. The latter two generally occur at the northern and northeastern edges of the treatment area.

Remotely Sensed Data

Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) are used extensively for vegetation mapping and monitoring because of the high availability and temporal resolution of the data. These attributes also make it particularly useful to track treatments and landscape changes over time. Repeat photography was taken at many of the treatments that showed the on-ground changes over time.

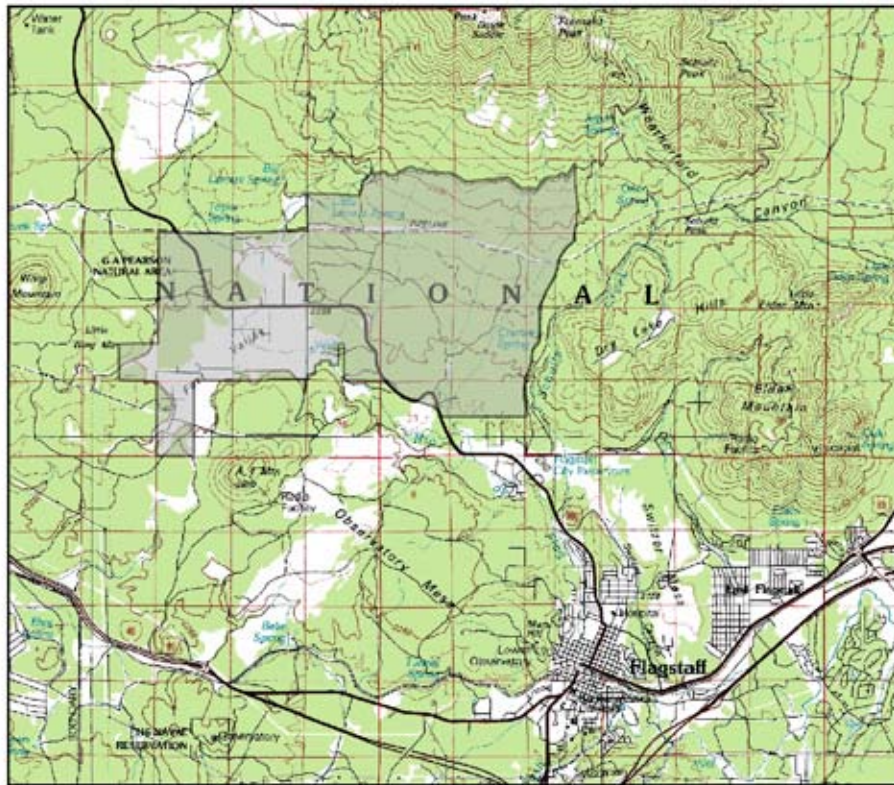


Figure 1. Fort Valley Unit. Note the proximity to Flagstaff.

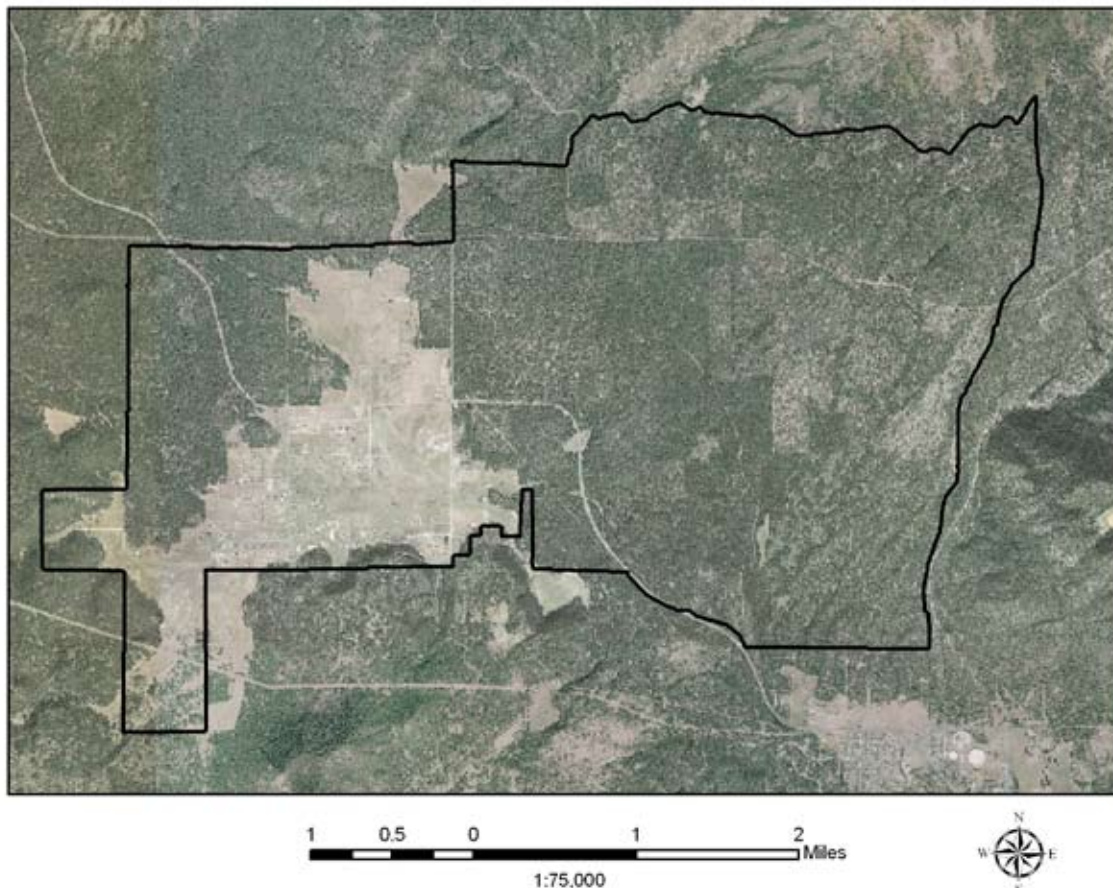


Figure 2. The Fort Valley area is in the western portion of the treatment area.

Results and Discussion

Figure 3 features proposed and completed treatments. Landscape changes, due to forest thinning and burning treatments are found in Figures 4 through 9. A steady progression of treatments is shown in the 1999 through 2003 satellite images. The 2005 and 2007 images clearly illustrate that much of the Fort Valley unit had been treated. Areas that had undergone prescribed burns can be seen, particularly on the 2007 image.

Figure 10 is a time series of photographs demonstrating the progression from an over-dense forest to an open forest that is closer to that of pre-settlement conditions. The top photo, from 1998 and taken pre-treatment, shows heavy tree cover, built-up fuels on the ground, and a lack of understory vegetation. The center photo, taken in 2000, shows a distinct lack of understory vegetation with the exception of mullein (*Verbascum thapsus*), an exotic species. The bottom photo, taken in 2006, shows that the mullein has been replaced with native grasses.

Conclusion

Forest treatments in the Fort Valley Unit, to improve forest health and reduce the likelihood of catastrophic wildfire, have been implemented over the last decade. Over time, the treated areas made up an increasingly greater proportion of the landscape. The ground photos show that treated areas do in many cases more closely resemble historical forests. The treatments should contribute to reducing the hazard of stand-replacing fire.

Remotely sensed data are a powerful tool for viewing forest restoration treatments. Most land management agencies have aerial photography archives that go back several decades that allow changes over time to be analyzed. Landsat satellite imagery will be available for free download in late 2008. This, and the high temporal resolution of Landsat data, make it well suited to look at landscape level treatments.

References

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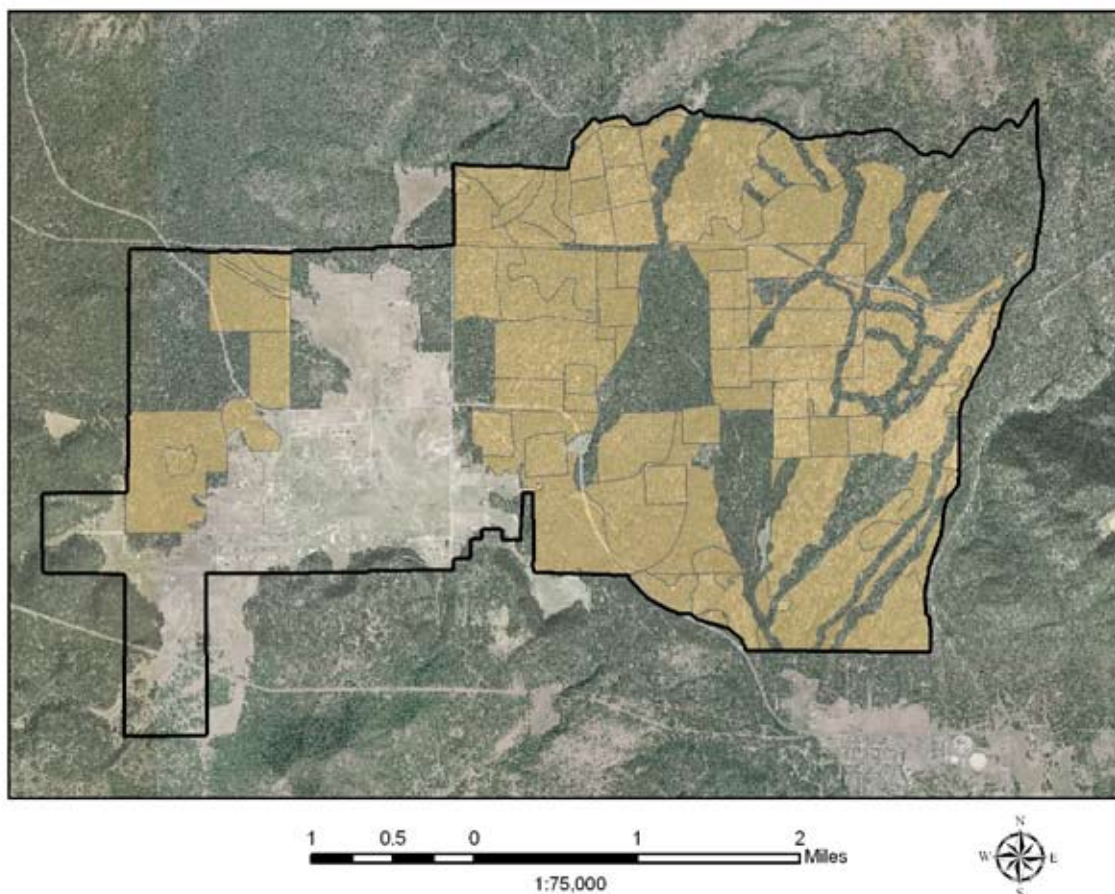


Figure 3. Fort Valley Unit treatments.

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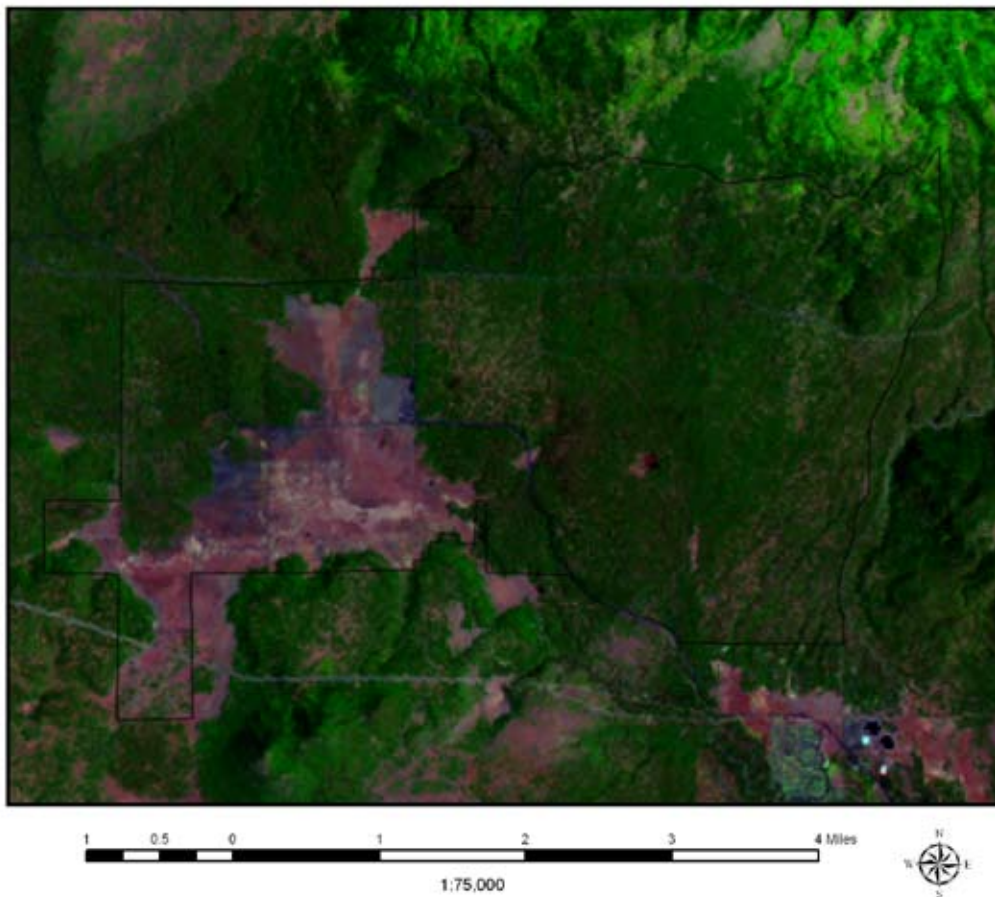


Figure 4. Landsat Thematic Mapper satellite image from June 19, 1996. This image shows the area prior to restoration treatments. Note the 1948 'Fort Valley' fire in the upper left corner of the image.

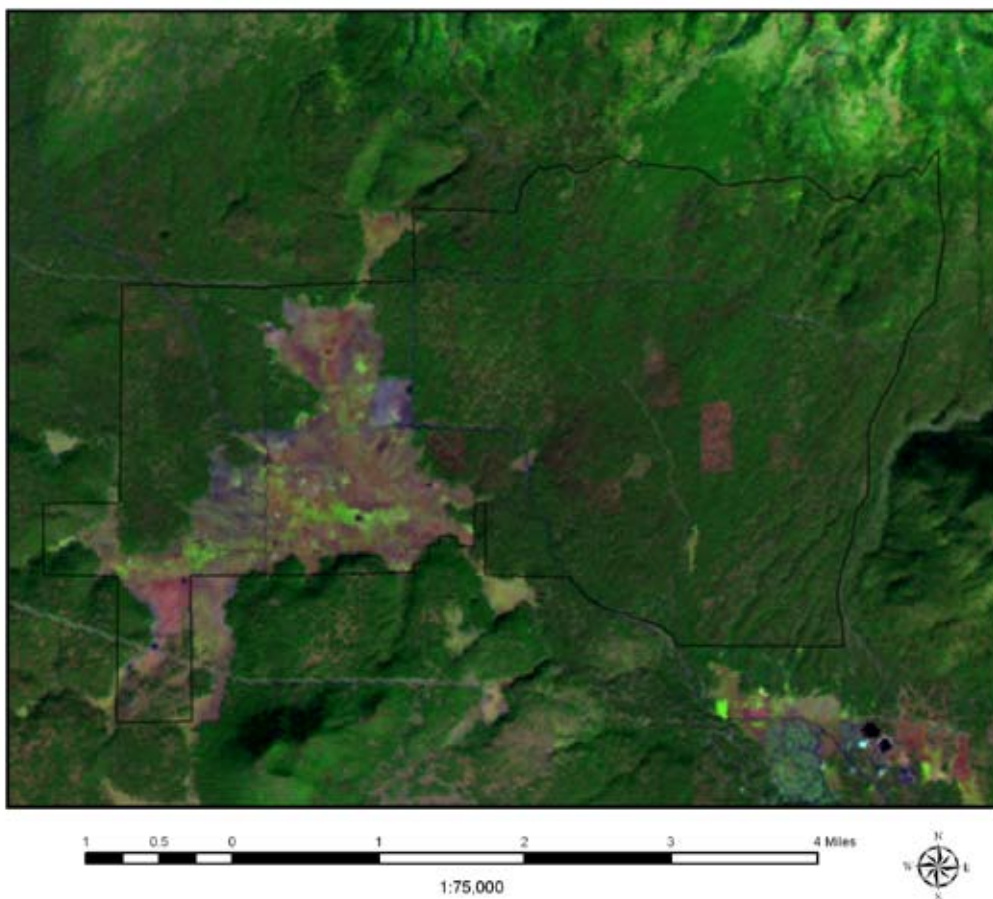


Figure 5. Landsat Enhanced Thematic Mapper image from October 10, 1999. The first restoration treatments are visible.

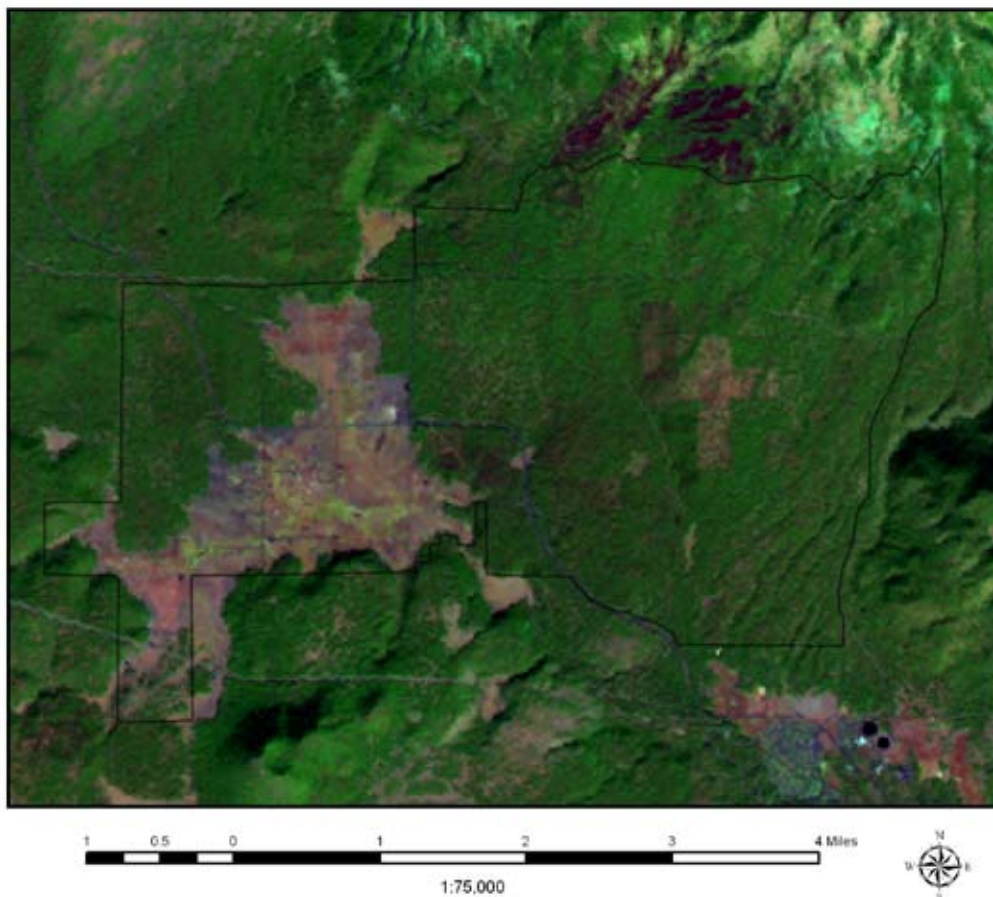


Figure 6. Landsat Thematic Mapper image acquired October 23, 2001. Restoration thinning and prescribed burning treatments are visible. Note the 2001 Leroux fire just north of the Fort Valley treatment unit boundary.

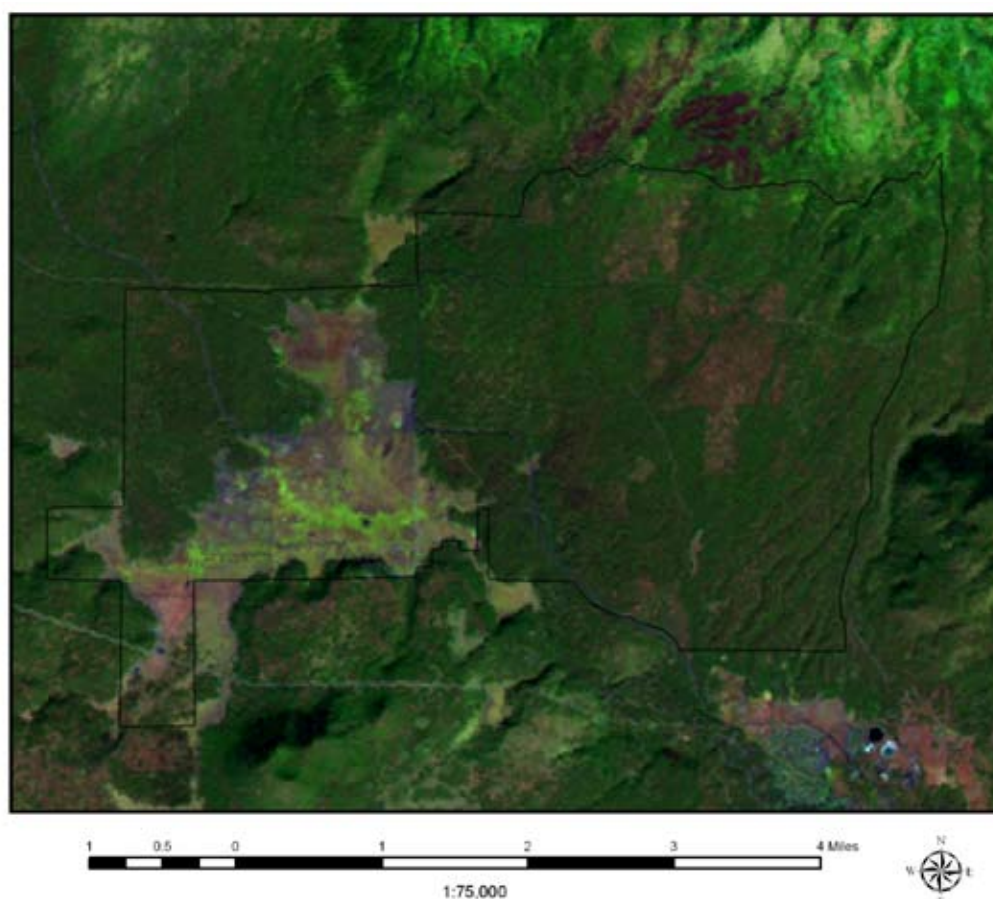


Figure 7. Landsat Thematic Mapper image acquired October 13, 2003. Additional restoration treatments are visible in the north-central portion of the treatment unit. The Leroux fire is still very clearly visible.

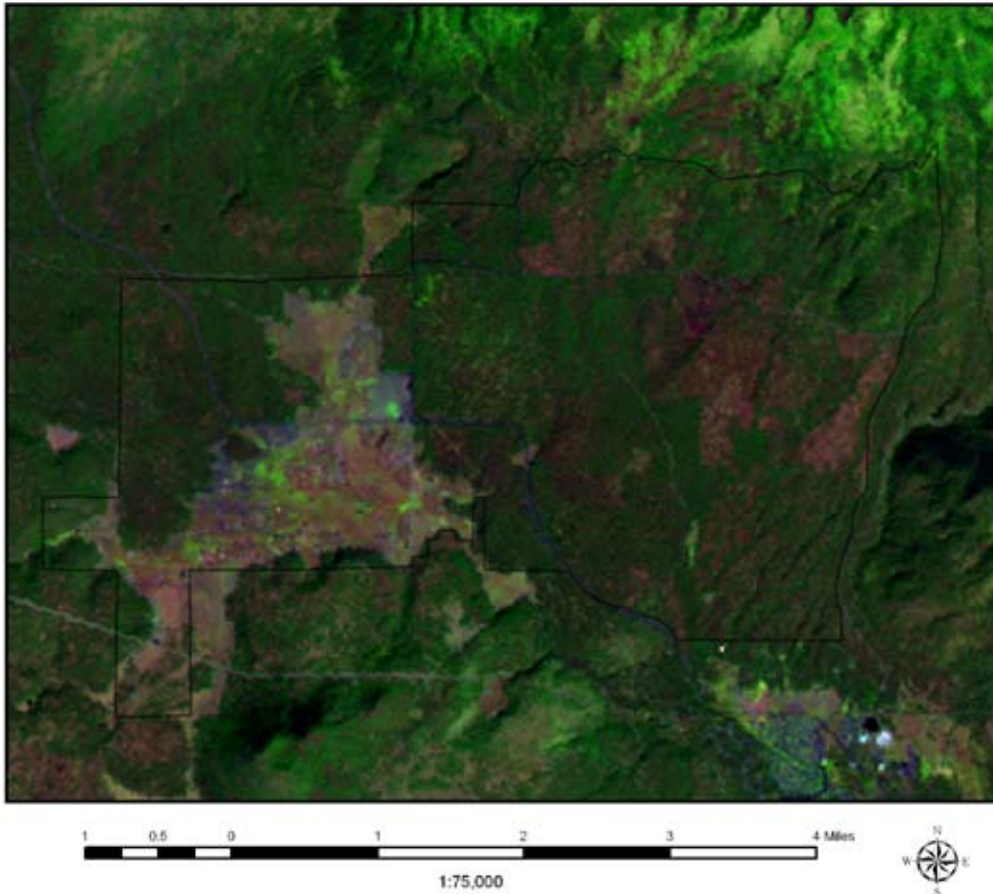


Figure 8. Landsat Thematic Mapper image acquired September 16, 2005. The addition of restoration treatments, particularly in the eastern portion of the treatment unit, can clearly be seen.

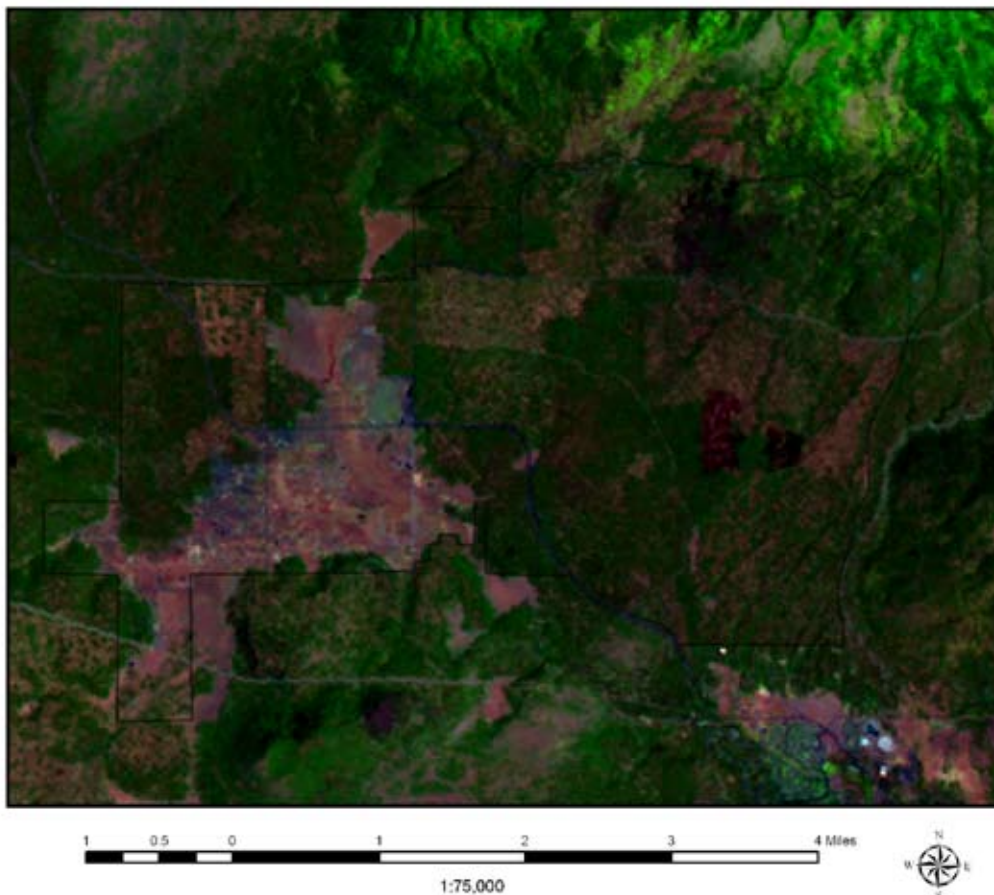


Figure 9. Landsat Thematic Mapper image from July 4, 2007. Restoration treatments have been conducted through most of the treatment unit. Note the large unit in the east-central portion of the image that had been recently returned. This particular unit was one of the first treated and is visible in all post-treatment images.



Figure 10. Repeat photographs taken from the same location. The top photograph was taken in 1998 prior to any treatment taking place. The center photograph is from 2000 and the reduction in tree cover is obvious. The bottom photograph is from 2006.



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