



## Monitoring Change: Pinyon-Juniper and Sagebrush Communities

### Importance: At risk of region-wide decline

City of Rocks National Reserve (Reserve) was dominated by sagebrush and grassland communities in the mid-1800s when westward-bound emigrants on the California Trail camped among the dramatic granite monoliths. The once sparse pinyon-juniper woodlands that intermingled with the rocky outcroppings have expanded across the landscape encroaching upon large portions of the sagebrush communities in the Reserve. This conifer expansion has occurred across the sagebrush biome in the Great Basin, raising concern about loss of sagebrush-dependent species and prompting various tree removal strategies.

Managers at the Reserve are striving to better understand the rates, causes, and consequences of woody expansion to preserve significant ecological and historical objectives.

### Long Term Monitoring

Methods to estimate vegetation cover were developed from a series of aerial photographs based on a stratified random sample of 340 plots distributed across key biophysical gradients (vegetation type and density, elevation, and solar radiation). Each 100 m x 100 m sample plot was over laid on digital aerial photos from 1950, 1990, and 2009 in GIS. For each time period, the percent composition of evergreen, shrub, and deciduous vegetation, as well as the transitional phase of woodland succession and recent disturbance events such as fire, insects, and harvest was quantified.



Repeat photographs 1868 (left) and 2005 (right) showing increase in woody vegetation (Morris 2006).

The results of the analysis reveal that in the absence of disturbance, the overall percent cover of woody, evergreen vegetation (including coniferous and evergreen broadleaf vegetation) increased by nearly 7% across the study area. Low-elevation and mid-elevation evergreen forests exhibited the highest rates of encroachment at 0.45%/yr. and 0.35%/yr., respectively, with pinyon-juniper forests in particular exhibiting the highest rate of encroachment among vegetation types at 0.37%/yr. Accounting for the effects of the widespread disturbances (namely fires) that occurred in and around the Reserve between 1950 and 2009 the overall extent of grassland and shrubland areas increased. Non-forested areas increased by 13% overall, while phase I (early successional) and phase II (mid-successional) woodland areas decreased by 37% and 41%, respectively, due to a combination of disturbances resetting to an earlier phase and succession advancing to a later phase. Phase III (late-successional) woodlands increased in area by over 100% during the 59 year time period, despite the loss of 7% of phase III plots to fire between 1990 and 2009. Our results are similar to other studies in the northern Great Basin which documented an increase of pinyon-juniper woodlands in sagebrush communities since the mid-1800s in areas not disturbed by fire.

### Monitoring Objectives

The goal of this study is to contribute to improving knowledge to aid management in this system. Specific objectives are to:

- Quantify the rate of change in woody encroachment and densification from 1950-2009 based on aerial photographs.
- Evaluate how rates of vegetation change over time varied with elevation, solar radiation, and current vegetation type and density.
- Estimate the spatial extent of changes in conifer, sagebrush steppe and grassland communities across the Reserve.

Over the past 4,000 years, the sagebrush and pinyon-juniper ecotone is known to have shifted repeatedly up and down slope in association with changes in climate and fire regimes. The relative roles of climate and livestock grazing, fire exclusion, and woodland clearing on conifer expansion over the last century are not well known. The concept of “natural range of variation” offers little guidance for management in this system. Instead, management may best be based on the specific objectives. Strategies may include use of prescribed fire or mechanical treatment to reduce pinyon-juniper density in areas of woody encroachment. They may also include protection of the original stands to favor the development of old-growth pinyon-juniper communities. Old growth communities may play a role in efforts to favor pinyon-juniper northward expansion under climate change.