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Research poster: Vegetation change in the Newberry Mountains of southern Nevada

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Vegetation Change in the Newberry Mountains of southern Nevada

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Study Area

The purpose of this research project is to show how vegetation communities have shifted to higher elevations over a 1500-meter elevation gradient in the Newberry Mountains over the last 30 years. The Newberry Mountains are located just north of Laughlin, Nevada, in the southern portion of Lake Mead National Recreation Area (LMNRA) (Figure 1). The National Park Service (NPS) manages most of the land in the Newberry Mountains and it is essential to effectively communicate potential changes in vegetation as a result of climate change. Understanding these potential changes will aid in developing effective federal land management strategies.

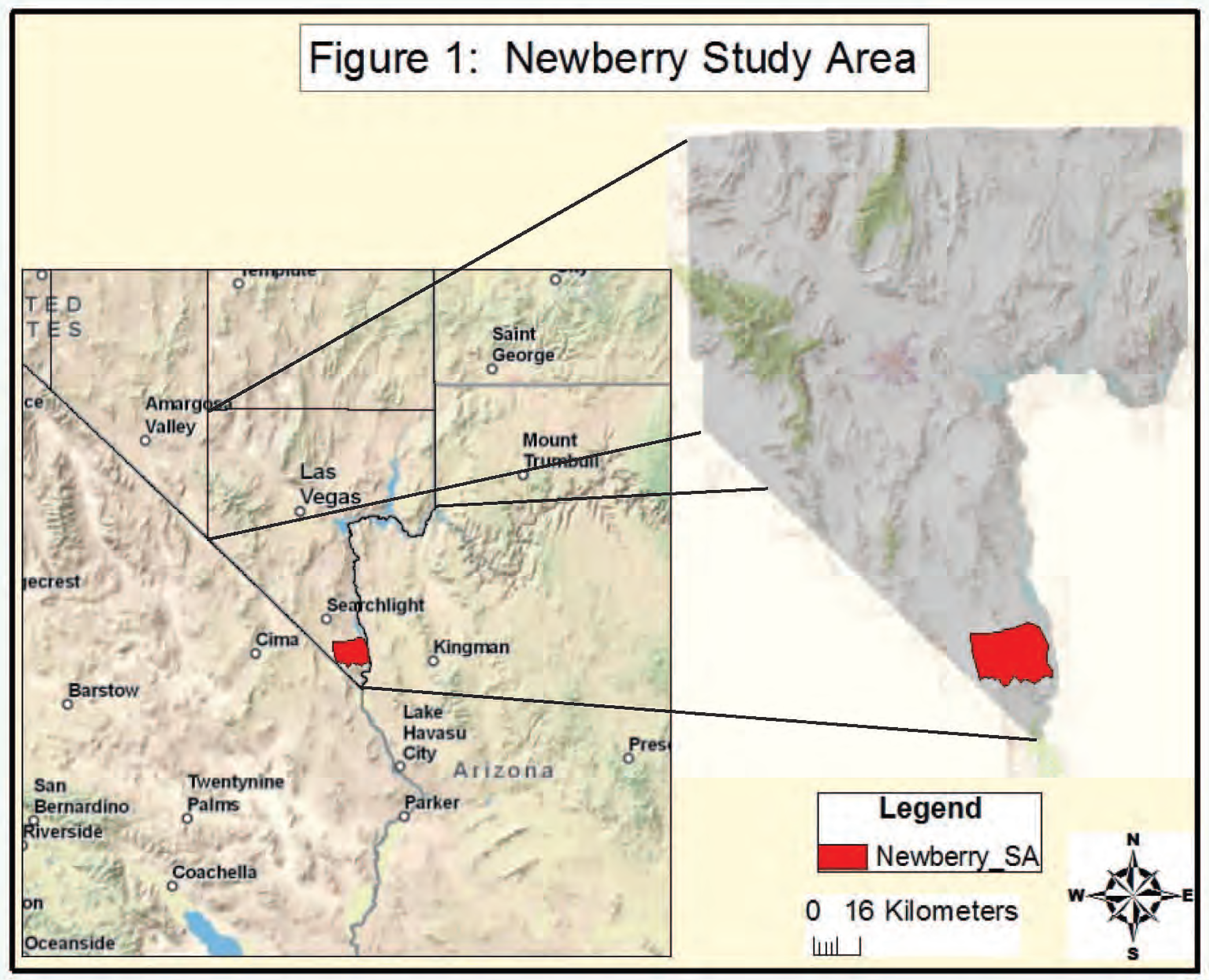


Figure 1: Study area digitized over data points with US topo maps background from the ESRI Online Resource Center

Background

Over the last century, biological communities are thought to have been affected by climate change induced by anthropogenic activities. For example, treelines have already migrated upward nearly 100 meters on mountains in New Zealand (Wardle and Coleman 1992) and forest types shifted upward 70 meters in Spain during the 1900's (Penuelas and Boada 2003). Effects of climate change on biota are anticipated to further accelerate in the coming decades. Biota will be exposed to increased CO_2 concentrations, warmer temperatures, and potentially reduced and temporally altered precipitation (Knapp et al. 2008). Introduction of exotic species and habitat fragmentation are examples of the many stressors that humans have placed on ecosystems, hindering the abilities of ecosystems to cope with climate change (Rice and Emery 2003). In the past, for example, species may have adapted to climatic changes by migrating to favorable habitat. However, the fragmentation and extinction of habitat provides barriers to such migrations during this present climate change (Allen and Breshears 1998). Thus, impacts on biota due to the present climate change are expected to be profound (Iverson and Prasad 1998). This is a significant problem for National Park Service lands which have been created in large part to protect significant biological communities. There is concern both about species migrating out of parks and the potential inability of species to quickly adapt to the changing conditions within these and other federal land boundaries.

Research Questions and Hypotheses

Question 1: What shifts in distributions of desert communities have occurred over the last 30 years across a 1,500 meter elevation gradient in the Newberry Mountains?

-*Null Hypothesis:* Biological communities have not changed on Park Service lands over the last 30 years and there is no discernable influence of climate change.

-*Alternative Hypothesis:* Biological communities have shifted over the last 30 years on Park Service lands and the shifts are influenced by climate change

Question 2: Based on the changes in the last 30 years what potential future shifts may occur by the year 2040 under simulated climate change?

-*Null Hypothesis:* No shifts in the spatial distributions of biological communities are anticipated due to climate change over the next 30 years.

-*Alternative Hypothesis:* Shifts in the spatial distributions of biological communities area anticipated over the next 30 years

Methods

In order to analyze changes in vegetation, precipitation, sunlight duration, and temperature, several datasets have been obtained. A 1979 dataset containing soils and vegetation community data will provide the baseline information to analyze the last 30 years of vegetation change in the Newberry Mountains. Using a global positioning system (GPS), the points were resurveyed during 2007-2008 allowing for direct comparison over a 30-year period. A major shortcoming of past modeling techniques has been the lack of on-the-ground data (Phillips et al. 2006). However, the 30-year record of potential changes provides an excellent chance for assessing the utility of species distribution models, such as Maxent or Bioclim (Phillips et al. 2006). These two models will be used on the 1979 dataset to see which one most accurately portrays the species resurveyed in 2007-2008. Model projections will then be extended multiple 30-years periods into the future to assess possible future shifts in community distributions.

To map and model changes in precipitation and vegetation shifts, ArcGIS 9.3 will be utilized. ArcGIS software allows for mapping and modeling changes in vegetation through the creation of multiple layers. Correlations between geomorphic indices (slope, terrain, soil type) can be shown using field data and aerial photos obtained by the University of Nevada- Las Vegas. Using ArcMap and ArcCatalog it is possible to create full databases for each dataset. The different data points can then be overlayed on aerial photos and remote sensed images in order to analyze vegetation. Other available data from ESRI like solar duration can also be used to assess changes (Figure 2).

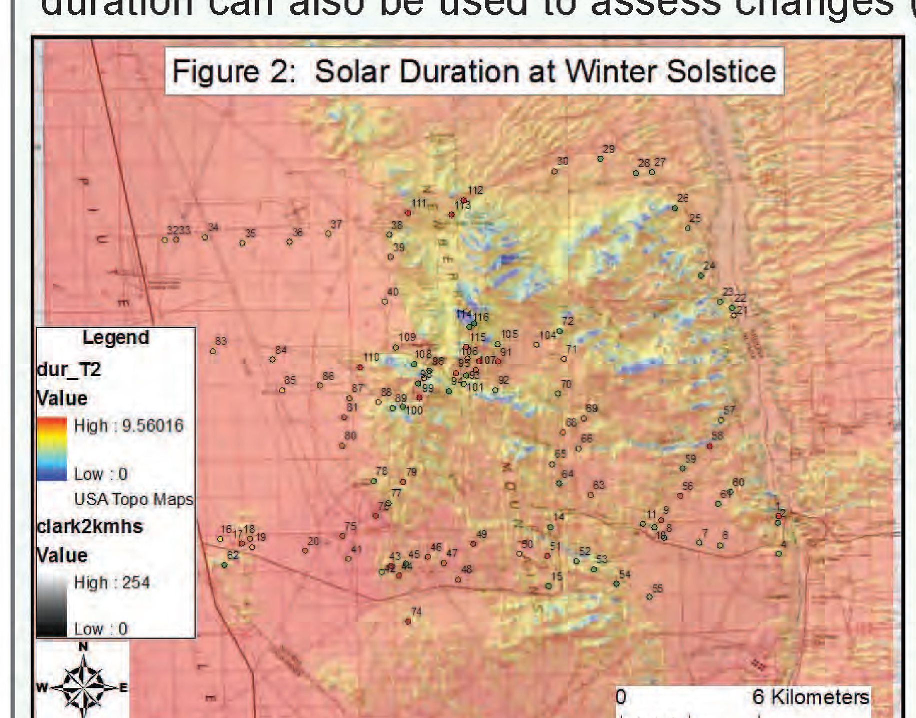


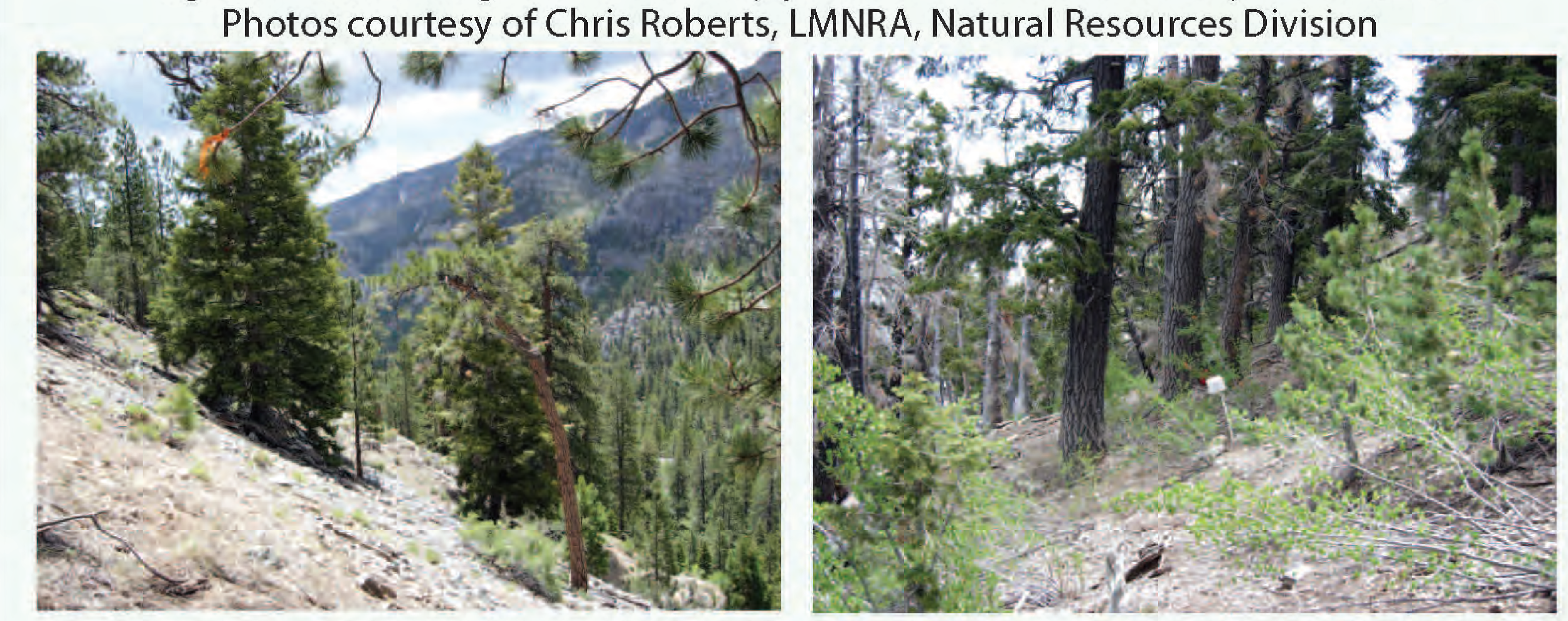
Figure 2: Solar duration map of the Newberry Mountains at the Winter Solstice. Data points overlay a topographic map from the ESRI Online Resource Center.

The main climate model used to analyze precipitation changes for the future will be the PRISM Model (Daly 2006). Daly (2006) showed the PRISM model to be the most effective precipitation climate model for areas of varying relief. Since our study area is the Newberry Mountains, the PRISM model is the most accurate model available. The PRISM Model incorporates elevation, slope, gradient, and temperature into one precipitation model.

Project Goals

(1) Determine the best model for accurately predicting vegetation changes in the Newberry Mountains (Figs. 3-4)
(2) Use the 30-year dataset to model past and potential shifts in distributions of desert communities
(3) Transfer findings to resource managers with NPS and other land management agencies
(4) Foster a meaningful two-way flow of data between researchers and stakeholders
(5) Produce original data and information which assists two-way flow of data into the future
(6) Use the results to produce geovisualizations with the new lab at UNLV to show future scenarios in an innovative way
(7) Use modeling techniques on other study areas like the Spring Mountains (Figs. 5-6)

Figures 3 and 4: Vegetation resurvey pictures from the Newberry Mountains. Photos courtesy of Chris Roberts, LMNRA, Natural Resources Division



Figures 5 and 6: Vegetation study pictures from the Spring Mountains. Photos from Scott Abella

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