29 years of vegetation community change across environmental gradients in a Mojave Desert mountain range

Christopher L. Roberts  
*University of Nevada Las Vegas*

James S. Holland  
*University of Nevada Las Vegas*

Scott R. Abella  
*University of Nevada, Las Vegas, scott.abella@unlv.edu*
Objectives

• Repeat vegetation transects surveyed in 1979.
• Establish permanent long-term vegetation monitoring sites.
• Compare data to assess vegetation community change.
• Share results with all stakeholders including government and tribal agencies and the public.

Hypothesis

• We sought to measure if changes have occurred between vegetation community structure in 1979 and in 2008 and if the degree of change differs with elevation and other environmental gradients.
• We expect most community change to occur in high-elevation plant communities.
• We expect reduction in coniferous woodlands and Blackbrush communities (Coleogyne ramosissima) due to fire and drought.
• We expect resultant incursion of species associated with lower elevations and the Sonoran desert.

Background

• Understanding long-term change in biological communities is a goal in ecology and is increasingly important for conserving unique communities and wilderness areas during a changing climate. The establishment of long-term vegetation monitoring sites with reproducible methods can provide opportunities for insight into vegetation community change and the directions of fire and other disturbances. This project is located in the Newberry Mountains of Southern Nevada which contain elevation and ecotonal gradients characteristic of the Eastern Mojave. Plots encompassed an elevation gradient of 120 to over 1,700 m from the hyper-arid Eastern Mojave. Plots encompassed an elevation gradient of 120 to over 1,700 m from the hyper-arid Eastern Mojave to mesic Pinion-juniper woodlands. GIS has provided these environmental parameters with lower elevations and the Sonoran desert.

Methods

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Results:

Plots surveyed in 2008 exhibited a higher mean Simpson’s diversity index (SI) than plots surveyed in 1979 (1.82 vs. 1.69). These changes in species diversity were driven by greater diversity in 2008 on the high-elevation plots (figure 1). Species compositional changes also have occurred, such as density changes among long-lived shrubs (figure 2) and plant life form (figure 5) in the absence of disturbance. Groups of ecologically similar plots were created from analysis of cluster dendrograms at the 75% level of information remaining (figure 4).

Figure 1). Characteristics of Site Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>1979</th>
<th>2008</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plots</td>
<td>51</td>
<td>52</td>
<td>0.80</td>
</tr>
<tr>
<td>Elevation Range</td>
<td>112 - 103 m</td>
<td>134 - 140 m</td>
<td>0.08</td>
</tr>
<tr>
<td>Total Area Surveyed</td>
<td>67.2 sq km</td>
<td>61.8 sq km</td>
<td>0.08</td>
</tr>
<tr>
<td>Species</td>
<td>1.63</td>
<td>1.71</td>
<td>0.03</td>
</tr>
<tr>
<td>Mean species/plot</td>
<td>1.63</td>
<td>1.71</td>
<td>0.03</td>
</tr>
<tr>
<td>Simpson’s Diversity</td>
<td>1.63</td>
<td>1.71</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Figure 2). Selected Species Data

<table>
<thead>
<tr>
<th>Species</th>
<th>Percentage</th>
<th>1979</th>
<th>2008</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larrea tridentata</td>
<td>30%</td>
<td>21%</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Eriogonum fasciculatum</td>
<td>78%</td>
<td>60%</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Coleogyne ramosissima</td>
<td>20%</td>
<td>12%</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Achnatherum speciosa</td>
<td>10%</td>
<td>5%</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Ferocactus cylindraceus</td>
<td>10%</td>
<td>5%</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3). Map of plot locations and Solar Insolation modeling.

Figure 4). Non Metric Multidimensional Scaling ordination of 1979 and 2008 plots with overlaid joint plots. Multiple Response Permutation Procedure (MRPP) for analysis of difference among groups (79 vs. 08) were conducted. Groups are different when p<0.05. The "A" statistic denotes the difference among groups with 1 being completely different and -1 being identical.

Figure 5). Change in abundance by life form.

1979 Data

2008 Data

** P<0.01

Conclusions

Our results reinforce the utility of long-term networks of monitoring plots for examining changes in ecological communities. The 29-year perspective was useful for detecting shifts in the distribution and abundance of plant species along environmental gradients. This is especially true for the Mojave desert where long lived plants are slow to respond to climatic change. Further analyzing the changes in individual species within respective environmental parameters will be useful in modeling potential directional shifts of the Mojave /Sonoran Desert ectone as well as directional shifts of plant communities along environmental gradients.

Acknowledgements

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