WILDLIFE BIOLOGY

## Where Did All the Deer Go? Investigating the Disappearance of Habitat from Historical Photos in a GIS System

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### Background

Over the last 50 years the Washoe-Lassen Interstate deer herd population, which straddles Longitude 120 degrees West between western Nevada and eastern California, has dropped from 50,000 to less than 3,000 animals. Loss of winter forage and thermal cover has been suspected as a major factor, but has not been accurately tracked. Two long-lived members of the Rose family, Curlleaf Mountain Mahogany (*Cercocarpus ledifolius L.*) - a small tree - and the shrub bitterbrush (*Purshia tridentata*) have historically provided the critical deer habitat, but fires and other changes have greatly reduced their populations. I have documented this change and analyzed the causes from aerial photos. While there is much overlooked information available in historical aerial photography, there are many obstacles to quantitative analysis of the data.

### Discussion

I assembled a series of aerial photos from 1954 to 1996 from BLM and other archives. These were scanned into a Map Image Processing System (MIPS) as raster images, where they were orthocorrected and georeferenced (placed in known map coordinates). Orthocorrection is necessary in steep, high-relief terrain to warp or rubber-sheet the images over the topography so that accurate area measurements can be made. These photos were then placed in mosaic in MIPS, and imported into ArcInfo and ArcView as TIFF files, where the polygons representing old growth mountain mahogany were digitized on the photos. In ArcView Spatial Analyst, Digital Elevation Models (DEM) of the terrain were clipped to the study area to derive large data sets which include the slope, elevation, and aspect of each of the 42,160 thirty-meter pixels. The digitized mountain mahogany coverage was then overlain on these sets, resulting in five data sets for 1954, 1974, 1993 (two sets - one of all trees young and old, and one of only old trees) and 1996, each with four variables (slope, elevation, aspect, and whether each pixel had mountain mahogany or not). Aspects (from 0 to 360 degrees) were transformed into a continuous variable with a range of 0 to 2, with 2 being the optimal value for a chosen aspect, to allow statistical analysis by regression. Multiple logistic regression in the SAS system was then used to examine relationships between the geographic variables and the presence of mahogany. A 50-year history of fire perimeters was digitized from hand maps in ARC/Info and added as a layer between the various photo mosaics.

### Conclusion

The resulting GIS project shows dramatically the decrease in the mountain mahogany stands after fires, and the resulting drop in deer populations. The results of this project also demonstrate that there is little regeneration of the very long-lived trees. It further shows that they have been increasingly restricted to higher elevations, gentler slopes, and northeast to northwest aspects (more common now than they were 50 years ago). Of special interest was the result of plotting probability curves (the probability of finding mountain mahogany at a given combination of aspect, slope, and elevation) for each of the five years of data sets. Data sets representing years soon after fire (1974, 1993, and 1996) had nearly identical curves. Data sets not representing the effects of recent fires, where new trees had opportunity to recruit, also had similar curves. However, curves in non-fire years were different from curves in fire years. The similarity within these two groups of curves suggests very strongly that the trees regenerate in the same areas after fires, and that fires tend to destroy trees in similar geographic locations over time. However, the distribution of trees killed by fires also shows the stochastic spread of fires. Field work has established that there are very few young and middle-aged trees present now to sustain the population - most of the surviving specimens are hundreds to perhaps over a thousand years old. Statistical analyses show the potential effect on mahogany survival of decreases or increases in slope and elevation and changes in aspect.

While the project represents an application of state-of-the-art computer technology and statistical analysis to data collected decades before such technologies existed, they also provide much direction for habitat rehabilitation techniques. Areas most suitable for replanting and reseeding have been identified and are being treated

with aerial seeding and seedling transplants. Those existing habitats most vulnerable to future fire are also being identified, and may be given priority for suppression or protected with vegetative strips where topography permits.

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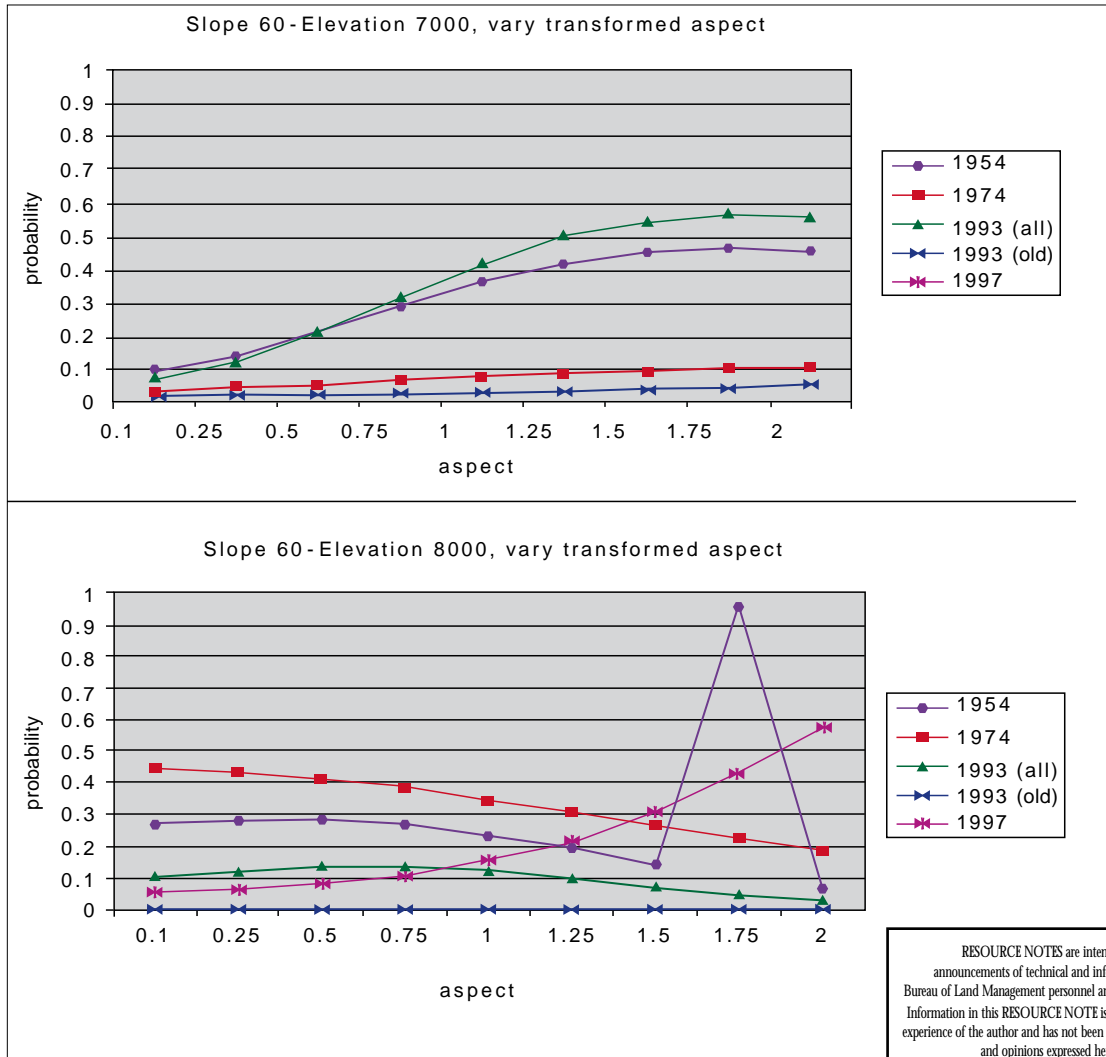phone (775) 861-6571
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**Figure 1.** Two sets of probability curves.