Volume 5
Wildlife Field Notes

Highways and Pronghorn Population Genetics across Northern Arizona

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Introduction

Fragmentation can be the most subtle implication of our transportation infrastructure, but it poses the greatest obstacle to long-term viability for many species. Highways can block access to resources, seasonal migration routes, and gene flow among neighboring subpopulations. Such a decline in genetic exchange can reduce variation and increase susceptibility to stressors such as disease or climate change, potentially leading to local extinction.

Fenced highways restrict gene flow, daily movements, and seasonal movements of pronghorn in Arizona.

Previous research has shown that pronghorn (*Antilocapra americana*) are particularly reluctant to cross roads. Their diurnal movements must contend with higher traffic volumes than their nocturnal counterparts (deer and elk) trying to cross the same road. Highway right-of-way fences designed to keep livestock off the road are an additional barrier to pronghorn, which prefer to cross under rather than over fences. Hence, fenced highway right-of-ways through pronghorn habitat pose a nearly impermeable barrier to pronghorn by presenting a triple barrier of fence, road, and fence.

Roads have been found to negatively influence population dynamics of many species, including desert bighorn sheep (*Ovis canadensis nelsoni*). However, studies of those species had to consider the preexisting population structure imposed by the natural landscape features. This study considers pronghorn genetic effects of fenced highways that bisect otherwise uninterrupted grasslands.

Study Methods

Biologists with Arizona Game and Fish Department (AGFD) collected pronghorn tissue samples during studies funded by Arizona Department of Transportation along two highways in northern Arizona: U.S. Highway 89 (US 89) and Arizona State Route 64 (SR 64) (*Figure 1*). Hunters contributed samples from pronghorn harvested across the study area. Then research

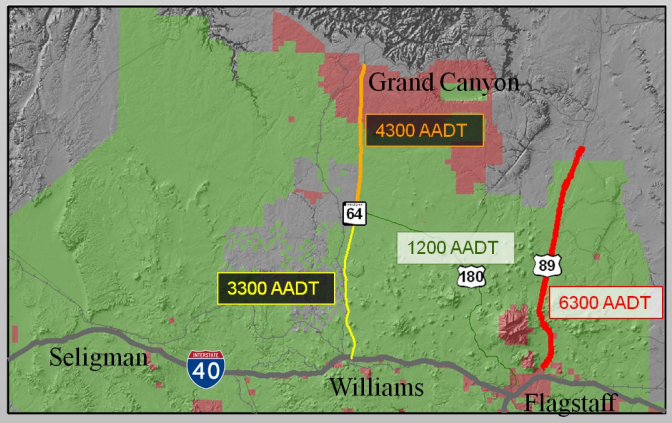

Figure 1. Northern Arizona highways with average annual daily traffic volumes (AADT)

ers from AGFD and Northern Arizona University isolated and amplified DNA at eight microsatellite loci for each sample. The resulting genotypes were entered into modeling software packages (STRUCTURE and GENELAND), which designate subpopulation membership. Researchers finally used additional genetic software packages to calculate values of relatedness within and among the modeled subpopulations.

Results

The findings delineated three subpopulations with boundaries closely aligned to US 89 and SR 64 (*Figure 2*). The number of migrants (samples collected on one side of the highway but genetically similar to the population on the other side) across a highway segment decreased as the traffic volume of that segment increased. The relatedness calculations also showed a divergence of gene pools but not a loss of diversity within subpopulations or individuals.

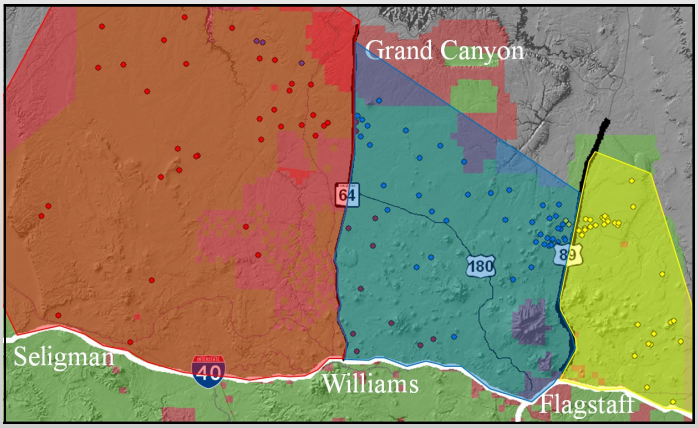

Figure 2. Modeled pronghorn population structure showing genetic differences across highways. Fewer migrants occur across higher traffic highway segments.

Management Implications

These findings show that even highways with moderate traffic levels, averaging 3000–6000 vehicles/day, can have substantial impacts on pronghorn gene flow. As traffic volumes increase, the barrier effect becomes more intense. It is possible that the restricted gene flow responsible for these diverging populations is sufficient to prevent genetic loss, but the gradual nature of this process could mean that such losses will yet manifest if the system remains static. Given projected traffic volume increases on these highways, future barrier effects would virtually assure genetic decline in some or all of these subpopulations, regardless of current trajectories.

Short and long-term measures will help restore connectivity across this landscape and prevent genetic collapse. An ongoing Wildlife Contracts Branch project is evaluating the effectiveness of pulling select segments of fencing away from the highways to allow pronghorn to cross one barrier at a time. Recommendations for crossing structures (*Figure 3*) and funnel fencing to promote safe pronghorn passage over or under the highway will be considered when the highways are reconstructed.

Figure 3. An artistic rendering of a wildlife overpass recommended for incorporation into US 89 reconstruction plans.

Special thanks to the Arizona Department of Transportation, Northern Arizona University, Federal Highways Administration, and the USFWS Wildlife and Sport Fish Restoration Program .