DRISI

Caltrans Division of Research, Innovation and System Information

Research Results

Comparing how highways affect gene flow in a disturbance-averse and a disturbance tolerant species

This research will examine whether highways are greater barriers for the disturbance-averse gray fox than for the disturbance-tolerant coyote.

Environmental

SEPTEMBER 2017

Project Title:
UTC - Using noninvasive genetics to compare how California highways affect gene flow in a disturbance averse versus a disturbance tolerant species, (NCST)

Task Number: 2978

Completion Date: April 1, 2017

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WHAT WAS THE NEED?

According to the Federal Highway Administration, American highways extend for over 4 million miles and have ecological effects on about 20% of the US land area. The "Moving Ahead for Progress in the 21st Century Act" passed by the US Congress in 2012 identifies the need for state and metropolitan agencies to reduce wildlife-related automobile hazards, reduce wildlife mortality, and improve habitat connectivity. Maintaining ecological integrity is an important component of Caltrans goal to develop and maintain a sustainable transportation system in California. In order achieve this goal, Caltrans need to have a robust understanding of how transportation systems affect ecological processes.

One ecological process that can be greatly disrupted by highways is wildlife dispersal. Highways can act as barriers to wildlife movement through direct mortality or through modification of natural behavior patterns. Roadway barriers can fragment and isolate wildlife populations, increasing their risk of extinction due to such things as genetic diversity loss and inbreeding depression. The degree to which highways affect species can depend on the species' ecological characteristics and features of highways themselves. Knowledge of how California highways impact wildlife with differing behavioral responses to disturbance will help Caltrans and other transportation agencies plan mitigation activities that will benefit multiple species.

WHAT WAS OUR GOAL?

This research will increase our understanding of how State Route 49 influences the genetic structure of the populations of two related sympatric species; the disturbance-tolerant coyote and the disturbance-averse gray fox. The results will improve our understanding of how California highways affect different wildlife species and provide preliminary data on how traffic volumes are related to wildlife movements across highways. The research team will collaborate on a 2 page policy brief and on a final research report to be submitted by the end of the project. The research report will contain the detailed methods used in the landscape genetics analysis as well as the detailed results of the analysis. The team will engage with National Center for Sustainable Transportation staff to disseminate the results of the study to policy makers involved in transportation planning. The research team will also disseminate the results to the scientific community through a conference presentation and in a peer reviewed journal article.

WHAT DID WE DO?

The objective is to determine the degree to which a species' tolerance to disturbance and highway characteristics influence a highway's impacts on gene flow of northern California wildlife. Specifically, the research team will:
1. Use landscape genetics tools to compare the impact of State Route (SR) 49 in Placer, Nevada, and Yuba Counties on movements of coyote and gray fox, two closely related sympatric species with differing affinity for disturbance.
2. Compare the degree to which traffic volume in three study sections of State Route 49 influence coyote and gray fox gene flow.

WHAT WAS THE OUTCOME?

A total of 327 mesopredator scats were collected from road transects on either side of SR 49, 213 samples originating from gray fox and 62 samples from coyote. It was then possible to obtain high quality genotypes for 19 coyotes and 90 gray fox. Of these, 14 and 57 were unique coyote and gray fox genotypes, respectively. Coyote samples were distributed equally on either side of the highway, with 7 individuals in both East and West of SR 49. In gray fox, there were 37 samples on the East side of SR 49 and 20 samples on the West side. There was no genetic structuring for coyotes or gray foxes across SR 49. Genetic clusters corresponded to family groups rather than side of highway. Genetic clusters for both species were found on East and West sides of SR 49 which suggest that at least some coyotes or gray foxes have crossed SR 49 either under bridges or through culverts or across the road surface when traffic rates are low. The results have shown that either 1) SR 49 is not a complete barrier to movement for either species or 2) that SR 49 is a barrier to coyote and gray fox movement but there may be a time lag between initial reduction of gene flow and detection of population structure.

WHAT IS THE BENEFIT?

The results of this study will improve our understanding of how California highways affect different wildlife species and provide preliminary data on how traffic volumes are related to wildlife movements across highways. Knowledge of how California highways impact wildlife with differing responses to human disturbance will help transportation agencies plan mitigation activities that will benefit multiple species. Future studies will target additional highways to increase the number of high, moderate, and low volume sections considered. The knowledge arising from this work will help transportation agencies target mitigation activities to stretches of highways predicted to provide the greatest barrier to wildlife movements. For example, crossing structures might be preferentially installed in highway stretches with high traffic volume to have the greatest impact on restoring population connectivity.