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SIERRAVILLE (CALIFORNIA) HIGHWAY 89 STEWARDSHIP TEAM: AHEAD OF THE CURVE

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Abstract: Highway 89 stretches from north to south across California, through Sierra County from Sierraville to Truckee. The highway bisects an important portion of the Loyalton-Truckee deer herd, as well as important habitat for forest carnivores, amphibians and other wildlife on the Tahoe National Forest.

By 2002, several groups were working independently to investigate different aspects of animal-vehicle collisions along the highway. These independent efforts were the:

- Continuation of a 20-plus year collection of carcass information on SR 89 by Caltrans
- Investigation of the effects of roadside forest thinning on roadkill by University of California-Davis Agricultural Extension Service
- Investigation of radio-collared deer movements across the highway by California Department of Fish and Game
- Applications to study the effects of deicing salt on deer attraction by the Sierra County Fish and Game Commission
- Long-term connectivity and habitat planning by the USDA Forest Service

These groups and their efforts were brought together in 2002 when they were catalyzed by the USDA Forest Service into a stewardship team to work together collaboratively to improve the high wildlife mortality and increasing habitat fragmentation on the highway. Most efforts to mitigate similar highway impacts are precipitated by a department of transportation project.

In the case of SR 89, no improvement for SR 89 was planned by Caltrans. Thus, instead of responding to a tight project timeline and budget, the Stewardship Team was able to proactively develop a connectivity and mitigation plan using Caltrans' large roadkill database, the Forest Service's large-scale habitat maps, and the other cooperators' information.

In 2004, Caltrans independently funded a \$720,000 wildlife-mitigation project on SR 89, thus allowing the Stewardship Team to use its connectivity plan as the basis for decisions on prioritizing wildlife crossing structures. The Stewardship Team is using the connectivity plan to propose further mitigation to Caltrans after the initial structure is constructed. The Stewardship Team has also secured grant funding to involve the local high school in a long-term investigation of how habitat connectivity and highway impacts are related.

This presentation traces the efforts of the Stewardship Team member agencies and how their diverse contributions, once coordinated, supported a grass-roots effort to mitigate highway impacts on SR 89.

Introduction

California State Highway 89 follows the east side of the Sierra Nevada Mountains for hundreds of miles through high sagebrush desert, rural ranching communities, and National Forest System lands (figure 1). Sierra County, California, has only a handful of small towns including Sierraville, none larger than 200 residents. North of Lake Tahoe, from the towns of Truckee to Sierraville, the Loyalton-Truckee Mule Deer Herd crosses the highway in large numbers during upslope and down-slope seasonal migrations. Resident deer cross within their home ranges numerous additional times.

Within the last five years, several groups of people independently recognized and tried to solve aspects of the deer/vehicle collision problem on Highway 89. Once these people were brought together into a cohesive team (the Sierraville Highway 89 Stewardship Team (Team)), their passion and skills resulted in a model example of grassroots accomplishments. This paper relates some of the Team's accomplishments to date and anticipated accomplishments for the future.

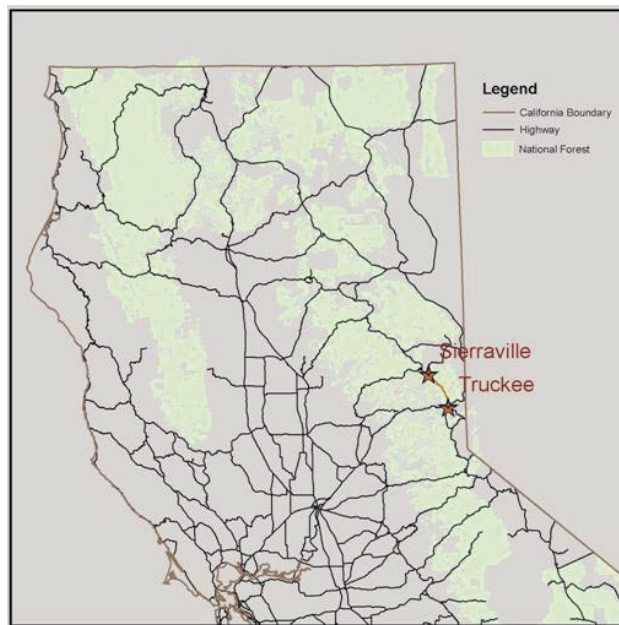


Figure 1. Northern California's State Highway 89 from Truckee to Sierraville.

The Team's experience is valuable to others because the combined efforts of several individuals and agencies have resulted in substantial accomplishments. The Team's contributions can be summarized in these areas:

1. No highway project is planned on Highway 89 for the foreseeable future. Therefore, any mitigation for highway impacts could not be rolled into another project, but instead must be a standalone. This determined the approach the Team would take to identify and promote mitigation opportunities.
2. Caltrans has consistently collected carcass data on Highway 89 for 23 years. While not unique, it is extremely unusual to have the longevity of a carcass database in an area that has seen few human developmental changes along a 16-mile distance (of the 33 miles total), thus allowing testing of the database for use in other situations.
3. The Team conducted a mid-scale habitat connectivity 'rapid assessment' (Ruediger and Lloyd 2003) of the lands within approximately 15 miles on each side of Highway 89. This connectivity assessment was based on readily available information gathered from local agencies, including USDA Forest Service habitat maps and the Caltrans carcass database. All species were considered, although the initial impetus for the Team's interest was deer/vehicle collisions.
4. The Team modified a process in use by Caltrans for some of its projects, the Value Analysis process (Caltrans 2003). This process helped select and prioritize opportunities for mitigation within the 33-mile stretch of Highway 89 between Truckee and Sierraville.

Stewardship Team Members

The Stewardship Team (figure 2) was formed when individual members realized others were working towards similar goals. Interestingly, prior to 2002 several agencies and individuals were independently working on aspects of the problem of deer/vehicle collisions. The California Department of Fish and Game (CDFG) had an ongoing research project to identify factors affecting the Loyalton-Truckee Mule Deer Herd. Among the issues were deer/vehicle collisions on Highway 89 and other highways within the herd's range. Sierra County Fish and Game Commission had inquired of Caltrans on the possibility of reducing deicing agents, which may attract deer to roadside edges. Caltrans was continuing to collect carcass data along highways in several counties.

Among the most complete and continuously collected databases was Highway 89, resulting in an excellent database. The University of California (Davis) Agricultural Extension Service had begun to use the Caltrans carcass database to investigate whether a relationship existed between forest fuels treatments along highway edges and deer/vehicle collisions. The USDA Forest Service's Pacific Southwest Research Station had begun to use Caltrans' carcass database to investigate how to extract the maximum amount of useful information out of it and similar databases used elsewhere.

The Sierra County Board of Supervisors submitted a grant to the Caltrans Transportation Enhancements for 'wildlife mitigation' along Highway 89. The USDA Forest Service was interested in the effects of Highway 89 and others on the connectivity of several wildlife species between widespread units of the Tahoe National Forest.



Figure 2. Sierraville Highway 89 Stewardship Team reviewing mitigation options in the field. Representatives are pictured from USDA Forest Service Tahoe National Forest and Pacific Southwest Research Station, Caltrans, California Department of Fish and Game, and Sierra Country Fish and Game Commission. Not pictured, Michael DeLasaux, UC Davis Agricultural Extension Service, photographer.

The Tahoe National Forest recognized that a combined effort would be needed to organize these disparate efforts and also that specialized expertise in wildlife and highway issues would be needed to tackle the challenges. The Pacific Southwest Research Station was requested to organize, lead, and teach the Stewardship Team until local individuals could take over.

Individuals working on all these efforts convened in spring 2003 and the Sierraville Highway 89 Stewardship Team was formed to more efficiently reach mutual objectives. The Team agreed on these primary objectives:

1. Increase traveler safety by decreasing deer/vehicle collisions.
2. Reduce vehicle-caused mortality to all species of wildlife.
3. Maintain or improve habitat connectivity for all species across the highway, especially as highway traffic volume increases over time.

Although many of the Team members originally became interested in the topic because of deer/vehicle collisions, the Team wholeheartedly agreed that multiple species were affected by Highway 89 and needed to be included in any mitigation efforts.

As the Team progressed towards identifying the problem and potential solutions, more people became interested in the project. The California Highway Patrol and the Sierra County local government became involved. Sierra County applied for a Title III Grant to involve local schools in the research and solution-finding efforts of the project, resulting in a grant of \$132,000. The California Deer Association granted the Team \$5,000 for team members' expenses.

Stewardship Team Assumptions and Agreements

The Stewardship Team agreed to take a comprehensive, large-scale approach to mitigate Highway 89's impacts to wildlife. First among these agreements was to consider multiple species rather than define the issue as a deer/vehicle safety issue. This agreement led to the understanding that habitat connectivity was as important to consider as vehicle-caused mortality. The Team further agreed that any mitigation would be a very long-term process, likely spanning two decades, and agreed to continue to champion mitigation efforts as long as needed.

At the time of the Team's formation, no budget existed for mitigation. The Team considered the lack of a constraining budget as an opportunity, because then we could choose mitigation based on its efficiency and priority, rather than by a project's budget limitations. Because Highway 89's impacts would require many individual mitigation solutions even as parts of an integrated mitigation package, the Team expected to promote improvement projects incorporating our recommendations or seek grants for separate mitigation projects.

Although formal agreement vehicles such as memoranda of understandings or the like have been discussed, to date the Team has no formal agreements.

Team members are seeking ways to use current accomplishments to leverage future research and mitigation opportunities. The Sierraville section of Highway 89 offers an unprecedented opportunity to conduct Before-After/Control-Impact studies, particularly using the long-term carcass database.

Initial Accomplishments

The Stewardship Team conducted a mid-scale connectivity analysis for all terrestrial species likely to be affected by Highway 89 using the general rapid assessment protocol of Ruediger and Lloyd (2003). We used available resources including local experience, habitat quality maps from USDA Forest Service data, the Caltrans carcass database, and mule deer movement information from the California Department of Fish and Game's ongoing research.

The connectivity analysis revealed few identifiable 'hotspots' where typical mitigation methods such as underpasses would work. Primarily this was because the topography allows for unconfined movements of many species, including deer, and the vegetation is homogeneous for long distances adjacent to the highway. Nevertheless, after field review, the Team identified five high priority locations between the Sierra/Nevada County line and Sierraville (16 miles).

The Caltrans carcass database is currently being used for several ancillary investigations. These will be the topics of future papers and are briefly described later in this paper.

Currently, no published tool exists to help transportation planners prioritize wildlife-mitigation sites within a highway stretch or to identify the tradeoffs among competing variables at each potential location. In a construction project, planning teams have a defined distance, timeline, and budget to constrain decisions. Often, interagency agreements define which species (if any) may receive status as worthy of mitigation. In the Sierraville Highway 89 project, no such constraints existed, therefore the choice of which target species, mitigation method, and location was unconstrained.

The connectivity analysis thus provided an excellent starting tool to identify and prioritize general locations and the species associated with those locations (figure 3). The species affected determine the range of mitigation options at a given site. Since the Team had no budget, cost was not a constraint, although we rejected solutions that were not cost effective. For example, the only mitigation solution currently available as a feasible engineering design in some of the hotspots would be an overcrossing; we rejected this option due to its high cost relative to the traffic volume expected in the next 50 years.

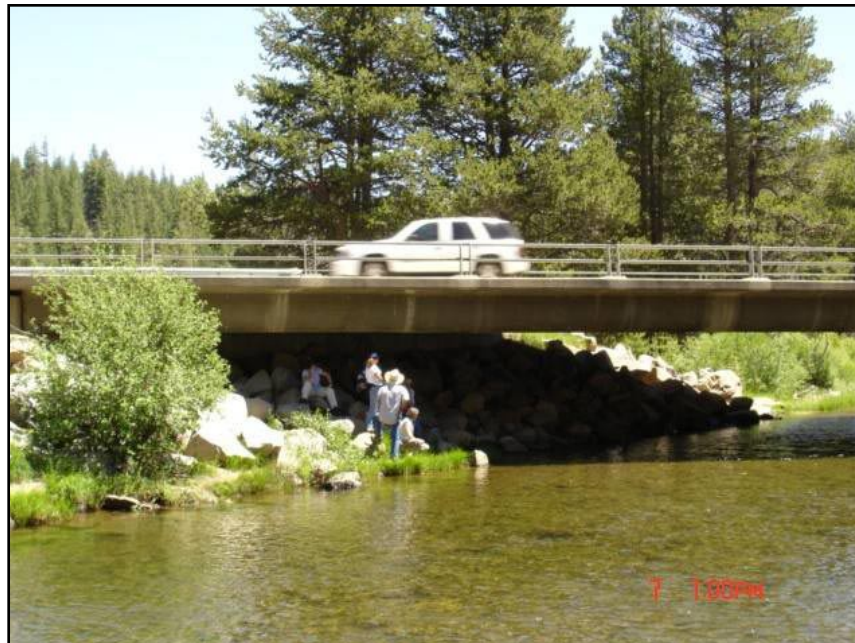


Figure 3. This bridge was determined by the connectivity analysis to be an opportunity for improving wildlife passage if the riprap could be made more wildlife-friendly. Image by Michael DeLasaux.

Transportation Enhancements Grant

At the time the Stewardship Team had completed the connectivity analysis and identified several potential mitigation options and specific locations, Caltrans notified us that the Sierra County Board of Supervisors Transportation Enhancements (TE) grant submission had been funded. The grant designates \$720,000 for 'wildlife mitigation.' Caltrans has the authority to choose the mitigation option. However, the agency has relied heavily on the Team's connectivity analysis and knowledge of the mitigation needs of the area in their required analysis stages.

Caltrans uses a Value Analysis study process on some of its projects (Caltrans 2003). This process helps improve the value of highway projects in several ways, including when multiple alternatives are identified or consensus is needed among stakeholders. The Stewardship Team modified the process to identify the best choice of location and mitigation type based on several variables defined by the Team. This process will be outlined briefly below and will be the subject of a future paper. Based on the connectivity analysis, field review, and the Value Analysis process, the Team recommended three locations and structure types to Caltrans as potential projects for the TE grant and requested a review from the agency to determine which of the options would be within the budget.

Caltrans agency engineers reviewed the Team's recommended options and determined that one of the options would be within the TE budget. This option was the Team's highest priority option (of the three chosen for this TE grant) as well (figure 3).



Figure 3. This site was chosen as the highest-priority location for an improved underpass suitable for all local species. Instead of replacing this box culvert, Caltrans engineers suggested installing an additional underpass 5 meters to the right of this view because of reduced installation costs. Image by Michael DeLasaux.

As of the date of this writing, the final decision on the type of mitigation option has not been chosen by Caltrans. However, it is likely to be an underpass at Kyburz Flat. In addition to an underpass, three small water-conveyance culverts were identified within the area to be fenced that could also be retrofitted to be suitable for small terrestrial fauna (figure 4).



Figure 4. The highest-priority mitigation option (a large underpass about 10 miles from this location) will need diversion fencing. The fencing will enable several other suitable, existing small culverts to function as small fauna passages because of the diversion. Image by Michael DeLasaux.

Funding for monitoring was included in the TE grant. This funding leveraged with other funds (including those from USDA Forest Service) will allow us to investigate experimentally for effectiveness several commonly used retrofitting options as well as new concepts, particularly with regards to noise moderation within the underpass.

Construction is planned for 2007. The Stewardship Team is prepared to continue to identify and seek funding for the remaining mitigation projects.

Modified Value Analysis

The Stewardship Team modified Caltrans' Value Analysis process so that we could have an objective, transparent, and repeatable means of identifying which mitigation project to fund first. Because the TE was submitted by Sierra County, we narrowed the choices to the mitigation projects within Sierra County.

We further narrowed the choices to the stretch on the Truckee (south) side of a side road that diverted a considerable amount of traffic from Sierraville because the rate of increase in traffic volume would likely be greatest in this stretch. Within the remaining stretch, five major areas for mitigation projects remained.

The Value Analysis process allowed us to identify criteria for choosing among the remaining mitigation options, rank those criteria to determine how close each criterion met the Team's objectives, and then rate each mitigation option for fit to the criteria. However, while the Team believed the Value Analysis process we used was very helpful in illuminating our decision rationale, we also believed the process needed additional work to be fully useful as a standardized approach elsewhere.

For example, feasibility ranked highest among all 11 criteria (figure 5). Aesthetics ranked lowest. In this case, aesthetics were never more important than any of the other criteria. Although aesthetics would therefore not be a decisive factor in choosing a mitigation option, the Team felt it was important to include it because several stakeholders mentioned aesthetics during Team discussions.

For purposes of our analysis, we did not include cost because the Team decided that if the TE grant would be insufficient to pay for our highest priority, we would seek additional funds, rather than choose a less functional option.

		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Performance Criteria Evaluation																
2				Feasibility	Aesthetics	Maintainability	Environmental Impact	Cost-effectiveness	Land ownership	Urgency	Habitat Quality	Multiple-species	Safety	Human Disturbance			
3	Criteria	A	B	C	D	E	F	G	H	I	J	K	Total	Percent			
4	A Feasibility	A	A	A	A	A	A	A	A	A	A	A	10	19			
5	B Aesthetics		C	D	E	F	G	H	I	J	K		0	0			
6	C Maintainability			C	E	F	G	H	I	J	K		2	4			
7	D Environmental Impact				E	F	G	H	I	J	K		1	2			
8	E Cost-effectiveness					E	G	H	I	J	K		4	7			
9	F Land ownership							G	H	I	J	K		3	6		
10	G Urgency									H	I	J	G	7	13		
11	H Habitat Quality										H	H	H	10	19		
12	I Multiple-species											I	I	9	17		
13	J Safety												J	2	4		
14	K Human Disturbance													6	11		
15													Total	54	102		<- rounding erro

Figure 5. Modified Caltrans Value Analysis process performance criteria used for evaluating the priority of each potential mitigation option along Highway 89. Each criterion is compared to all others and ranked in relative closeness in meeting the Stewardship Team's objectives.

The 11 criteria we used, in order of importance, were:

1. Feasibility
2. Adjacent habitat quality
3. The capability of the mitigation option to meet multiple species needs
4. Urgency (are conditions changing or are ephemeral opportunities available?)
5. Presence of human disturbance
6. Cost effectiveness
7. Adjacent land ownership
8. Maintainability
9. Safety
10. Environmental impact (of the mitigation itself)
11. Aesthetics

Safety ranked relatively low because the Team reasoned that functional mitigation would provide safety benefits and that mitigation options that provided safety benefits (but not ecological benefits) were less desirable. Many of these criteria are similar to those identified in the decision matrix used in Florida (Neal et al. 2003).

Caltrans Carcass Database

Carcass databases over unbroken, long-duration timespans are rare, particularly with consistently collected data. Further, carcass databases are more useful for information on wildlife issues than animal/vehicle collision data because many vehicle owners do not report animal/vehicle collisions.

Caltrans has collected information on carcass locations throughout many locations in California. However, the quality of the data is dependent on numerous factors, including the relative importance placed on it by maintenance supervisors over the years. The Sierra County section of Highway 89 is unusually complete and of long duration. Nevertheless, it was collected by crews of typical highway maintenance workers untrained in statistics. It is therefore an excellent database to use to determine how useful such databases are to inform decisions on mitigation options.

Pacific Southwest Research Station is currently developing a Microsoft Excel-based tool to help transportation planners answer some first approximation questions. One such question is how long it may be necessary to collect carcass data to identify 'hotspots' on a given stretch of highway under user-identified circumstances. The definition of 'hotspot' is user identified as well because some DOTs may have guidelines already.

This tool can also be used as a first approximation of hotspots if users have little or no habitat information available for greater interpretation. Hotspot locations have limited utility for informing decisions on mitigation options; however, a first approximation with a simple tool may help transportation planners determine if further investigation of hotspot data with a more sophisticated tool may be useful.

The Caltrans Highway 89 carcass database is being used as one of several similar databases from around North America as part of the National Coordinated Highway Research Program's project 25-27: Evaluating the Effectiveness of Wildlife Crossing Structures. These databases will be used to develop and refine much more sophisticated tools for carcass and vehicle-collision databases, especially those with GIS-based habitat information available.

These results and tools will be available in a future publication.

Biographical Sketch: Sandra L. Jacobson is a wildlife biologist/research and management liaison at the Pacific Southwest Research Station, Redwood Sciences Laboratory, Arcata, California. Education: B.A. in zoology (1983), Humboldt State University, Arcata, California; M.S. in natural resources/wildlife (1986), Humboldt State University. Jacobson has served as a wildlife biologist for the USDA Forest Service since 1980, working on three national forests at the district and forest levels in California and Idaho. She has worked for the USDI Fish and Wildlife Service, California Department of Fish and Game, and the USDA Soil Conservation Service. As the district wildlife biologist for the Bonners Ferry Ranger District on the Idaho Panhandle National Forests for 13 years, she managed grizzly bears, woodland caribou, and other threatened or endangered wildlife in an interagency and international setting. Ms. Jacobson is the lead biologist for the Wildlife Crossings Toolkit website. She is a charter member of the Transportation Research Board's Task Force on Ecology and Transportation and a team member for NCHRP 25-27's Evaluating the Effectiveness of Wildlife Crossing Structures. She is a member of the UC Davis Road Ecology Center's Scientific Advisory Committee. Currently, Ms. Jacobson is providing project-level technical expertise and training on wildlife and highway issues for several agencies around the country while acting as a research/management liaison at the Pacific Southwest Research Station.

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