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MEMORANDUM

To: **All Interested Parties**

From: Thomas F. Tracy, Road Commissioner/Public Works Director

Date: February 20, 2003

Subject: **Final Report: A Program to Reduce Collisions with Animals**

cc:

Attached for your information is a copy of the final report on a deer whistle project we have just completed, called A Program to Reduce Collisions with Animals.

In this project, funded through the California Office of Traffic Safety, we distributed, free, 1,648 air actuated and electronic deer whistles to vehicle owners over a period of two years. There were no collisions reported to the California Highway Patrol between deer and vehicles owned by drivers to whom we distributed these deer whistles. Analysis indicates the level of confidence that the deer whistles are responsible for this decrease in collisions is about 99.6%.

Please feel free to contact me with any questions or comments at the above address, at (530) 233-6414, or e-mail ttracy@hdo.net.

A PROGRAM TO REDUCE COLLISIONS WITH ANIMALS

Geographic and Demographic Setting

Modoc County is a rural county at the extreme northeast corner of California. Its area is 4092 square miles, with 72% of its land in Federal and State ownership, mostly in the Modoc National Forest. The terrain is mountainous to high-desert plateau, with elevations ranging from a base of about 4300 feet, to Eagle Peak at 9934 feet. The county is home to about 9,450 people, with a population density of 2.3 persons per square mile. There is one incorporated city, Alturas, with about 2900 residents. Wildlife abound. There are more mule deer than people in the county, and there are also antelope, mountain lions, elk, and many other kinds of animals, birds, and fish. See the project location map on page 9 in the Appendix.

The Specific Traffic Accident Problem

Within Modoc County's borders are 1000 miles of county roads, 180 miles of state highways, 1500 miles of forest roads, and 33 miles of streets in the city of Alturas. The roads of all four jurisdictions are crossed often by wild animals, particularly the mule deer that are present throughout the county. Even Alturas has its resident herd of mule deer. All County and State highways are two-lane, and many roads pass through either forest or terrain with sufficient trees and bushes to obscure deer from motorists.

In Modoc County over the last seven years, about 15% of all accidents have been caused by animals, including one fatality and several injuries to humans. The percentage jumps to 23% when only the last four years are considered. This is compared to the nationwide average of deer collisions to total accidents, which is 4%. About 11% of accidents on state highways in Modoc County were caused by deer. Over the last seven years, collisions with animals is the single greatest cause of accidents on the county roadway system, greater than either alcohol-related accidents or speed-related accidents. Over the last four years, because of a decrease in DUI's, collisions with animals are the cause of more accidents than alcohol and speed together.

On the roads where vehicles travel at highway speeds, the county and state roadways, these animals present a safety hazard. The adult male mule deer typically weighs 200 pounds, and can grow to 300 pounds, enough to cause significant body damage to a car, and stands high enough to severely impact the hood and windshield of a standard size car when struck. Deer also will stand in the forest near highways and dart onto the road in front of vehicles, or even stand on a roadside bank and jump onto the road in front of, or onto, cars.

Compounding the safety hazard is the natural reaction of drivers to turn the steering wheel to avoid hitting deer. In the fraction of a second a driver has to react, he sometimes chooses to try to avoid hitting a deer, and steers to either side toward a

roadside tree or ditch, or even into an oncoming vehicle. This is the chain of events that produces serious accidents, and death or injury to humans.

There are several unusual factors pertaining to deer collisions:

- Most deer-auto collisions go unreported. The collision reports we have from the California Highway Patrol are undoubtedly only the more serious crashes, so that the actual number of these collisions may be five or ten times higher. The point here is that any collision with deer has the potential to become a serious crash.
- Collisions involving deer can happen to anyone, almost without regard to the driver's ability or caution. Whereas a person can choose to not drink alcohol and thereby avoid most alcohol-related collisions, and choose to drive within the speed limit and thereby avoid most speed-related collisions, there is very little a driver can do to avoid crashes caused by animals.
- Crashes involving deer receive little publicity. They generally happen in rural areas, where there are no big-city newspapers or television channels. The estimates of human fatalities nationwide from deer collisions range from 100 to 300, and there are an estimated 300,000 to 500,000 deer killed nationwide each year in these collisions.
- Crashes involving deer are often not location-specific. Traditional traffic engineering focuses on high-collision locations, as identified by pin maps or their electronic equivalent, but deer travel everywhere, at least in Modoc County, so that the best strategy for preventing deer collisions is to do something to the vehicle or to assist the driver.

Possible Solutions to the Problem

There are standard deer warning signs on major roads throughout the county, but little evidence that drivers slow because of these signs. Some vehicles are equipped with air-actuated deer whistles because drivers purchase them and install them on their vehicles. Proportionately only a few vehicles have these, and there is no coordinated tracking activity to confirm how effective the deer whistles are. Other than these two items, there are no safety systems that address collisions with animals in Modoc County. Note that the General Motors night vision equipment shows promise, but at present it is very expensive, comes on only one type of vehicle, and cannot be retrofitted on cars.

The Modoc County Road Department has not attempted to solve the problem of deer-vehicle collisions, other than to install standard deer warning signs. We are not aware of any organized effort to solve this problem over a large area. A few deer fences have been constructed elsewhere at spot locations where deer cross highways, but this strategy is not practical for an area with 2700 miles of roads. Other experimental solutions have been tried at specific locations, but these are costly and would be ineffective in Modoc County, with its extensive area of deer presence. A few drivers have installed deer whistles on their cars, and the CHP also does, but effectiveness statistics are not available.

Deer whistles produce ultrasonic sound that apparently deer can hear and that generally causes deer to stop motionless for a few seconds. There are two types of deer whistles: air velocity operated and electronic. Air velocity whistles are much less expensive, but have some drawbacks, such as becoming clogged with insects or ice, and

coming off the car's bumper in a car wash. The electronic type is more expensive ($40 compared to about $6 for a pair of air velocity whistles), but avoids the drawbacks of the air velocity whistles.

Project Goals and Objectives

The stated goal of this safety project is to reduce significantly the number of collisions involving vehicles and animals, particularly deer, in Modoc County from the 1998 to 2000 annual average number of 19 reported crashes to an annual average of 10 or fewer reported crashes by December 31, 2002. The success of the project was measured by the number of animal-involved crashes as noted on the collision reports prepared for each crash by the California Highway Patrol.

The project objectives are:

1) To ensure that deer whistles are installed on at least 50% of the registered vehicles in Modoc County by December 31, 2002.

2) To analyze collision data and compile a report on the effectiveness of the different types of deer whistles used and to make the report available to interested agencies, including other rural jurisdictions with like safety hazards by December 31, 2002.

3) To collect success stories and forward them to the Office of Traffic Safety with the quarterly report throughout the project period.

Project Methodology

We purchased both air velocity and electronic deer whistles and distributed them free to owners of vehicles registered in Modoc County and owners of vehicles often driving through the county. The photograph on page 10 shows the three types of deer whistles we distributed. There are about 8,300 vehicles, excluding trailers, registered in the county, and some of them already had deer whistles attached. We promoted the program with 41 two-column by six inch newspaper advertisements, and one unpaid newspaper story, in the *Modoc County Record*, the only newspaper in the county, with a general circulation of about five thousand persons, or about half the county population. A copy of the newspaper advertisement is shown on page 11.

We recorded the names and license plate number of drivers receiving the whistles, and later compared the license plate numbers with license plate numbers of vehicles involved in reported deer collisions, as determined from CHP collision reports. The database format is in Microsoft Access, and a sample is shown on page 12. We also issued instructions for installing the deer whistles and requested drivers to telephone or write to us about their experiences with the whistles. A copy of the flyer requesting feedback is shown on page 13. We tracked the program for two years, and issued quarterly and final reports on the success of the program. Personnel involved in the program include the project manager, the traffic engineering technician, and the department accountant/receptionists who explained the program and distributed the whistles to members of the public and recorded license plate numbers.

The phases of the project are as follows:

PHASE 1 – PRE-PROGRAM PREPARATION (11/01/00 to 12/31/00)

Contact researchers on deer-vehicle collisions.
Contact deer whistle manufacturers.
Discuss with the CHP crash data transfer procedures.
Customize software to handle data on vehicles with deer whistles.

PHASE 2 – EQUIPMENT PURCHASE AND DISTRIBUTION (01/01/01 to 10/31/01)

Purchase a moderate number of various types of deer whistles.
Verify the production of high frequency sound.
Advertise the availability of free deer whistles.
Distribute deer whistles, and record vehicle data and whistle type.

PHASE 3 – DISTRIBUTE REMAINDER OF DEER WHISTLES (11/01/01 to 12/31/02)

Purchase the remainder of the deer whistles, as existing stocks are distributed.
Continue advertising the availability of free deer whistles.
Distribute the remainder of the deer whistles.

PHASE 4 – DATA GATHERING, ANALYSIS, AND REPORTS (Throughout the program)

Gather and maintain data on deer whistle type and vehicles in which they are installed.
Analyze crash data, past and ongoing, to determine effectiveness of deer whistles.
Prepare quarterly reports and final report.
Maintain data on how many paid print ads occurred and the estimated size of the audience.

Minor Project Difficulties

There are several uncertainties attending this program. The first is that no definitive study has yet verified the effectiveness of deer whistles. Previous research has been limited, and results have been mixed. There is general consensus that deer whistles are effective some of the time, but no one claims total effectiveness. The second uncertainty is that there are statistically few deer-vehicle collisions, so that statistical certainty may require more data than has been obtained in the two years of this program. The third uncertainty is that outside factors unrelated to this program may affect the results. Both the severity of the winter and the abundance of mountain lions influence the numbers of deer, so that the number of deer-vehicle collisions may be affected by these outside factors.

The distribution rate of deer whistles, and thereby the success of the program, is largely dependent on the actions of individual members of the public. We advertised the availability of deer whistles, and waited for people to come to our office to obtain them, but we cannot require drivers to take the whistles or to install the whistles on their vehicles. Over the two-year period of the program, we could distribute sufficient whistles to install on only about 20% of the vehicles registered in the county.

Analysis of Project Data

In order to estimate the efficacy of deer whistles, we analyzed the reported accident data using the chi square contingency analysis. Two different methods are used and compared. All analysis is based on collisions reported to the CHP.

Both chi square tests utilize the general formula

$$X^2 = \sum \frac{(E-O)^2}{E}$$

where E is the expected value of frequencies, and O is the observed value. Standard chi square distribution tables are used to determine the levels of significance.

The first analysis entails comparing the accident rate of vehicles that had deer whistles we distributed with the accident rate for vehicles that did not have deer whistles we distributed. Both rates are for the period January 2001 through December 2002, on both state and county roads. The total number of registered vehicles in Modoc County, excluding trailers, is approximately 8,300 throughout the study, and for at least five years previously. We will use this number throughout the analysis as an approximation of the total number of vehicles moving in the county. The number of vehicles with our deer whistles is 1,648, which we will use for the entire period. The contingency table for the first analysis is shown below, with the calculated expected values shown in parentheses.

1/1/01 to 12/31/02	NOT HIT DEER		HIT DEER		TOTAL
HAD DEER WHISTLES	1648	(1642.242)	0	(5.758)	1648
NOT HAVE WHISTLES	6623	(6628.758)	29	(23.242)	6652
TOTAL	8271		29		8300

The number of degrees of freedom is one. The value for chi square is calculated as 7.209. The chi square distribution table shows that the level of significance is about 99.3%, normally considered statistically significant.

The second analysis utilizes seven years of accident data. We calculate the expected rate of collisions with deer for the 1,648 vehicles with deer whistles based on accident data from the same period as above for both state and county roads, and compare it to the observed accident rate. The accident data and contingency table are shown below, with the calculated expected value shown in parentheses.

	1996-2000	1/1/01 to 12/31/02 (no whistles)	1/1/01 - 12/31/02 (whistles)
HIT DEER - STATE ROADS	33	17	0
HIT DEER – COUNTY ROADS	24	12	0
TOTAL	57	29	0 (11.712)
VEHICLES	8300	6652	1648

The number of degrees of freedom is one. The value of chi square is calculated as 11.712. The level of significance is approximately 99.94%, considered statistically significant.

Results

There have been no reported collisions with deer on any of the 1,648 vehicles owned by drivers to whom we distributed deer whistles, over a period of about two years. These include 418 Hornet electronic whistles, 831 air-actuated Wagan whistles, and 387 air-actuated Save-A-Deer whistles. From a statistical standpoint, the expected number of reported collisions with deer for this number of vehicles is about 5.7 over this time period, and there is a 99.6% confidence level that the deer whistles are the cause of the reduction in collisions. For the comparison period from January 1, 1996, to December 31, 2002, there were 89 reported collisions with deer in Modoc County, with 29 reported collisions during the immediate study period of January 1, 2001, to December 31, 2002. All of these collisions involved vehicles not in our database of vehicles to whose owners we distributed deer whistles.

Based on nationwide statistics from 2000, we have determined that the expected cost of these 5.7 collisions is about $72,000. See the table on page 14 in the Appendix. Since the program cost $26,764.90 in Federal grant funds, there is an apparent benefit/cost ratio of 2.7 for this project. The calculated cost of crashes prevented is 2.7 times the cost of the program. This is the first, immediate, result of the project.

From a long term perspective, if the results of this project can be replicated elsewhere for longer periods of time, the benefits will be significant. It should be noted that vehicle collisions with deer and similar animals are a problem in many parts of the United States and the world. Reducing the incidence of these collisions would save money, injuries, and lives. The key is informing people of the results of this project, and encouraging them to install deer whistles on their vehicles.

Over the two-year course of the project, we have received telephone calls from three different drivers about minor collisions with deer that were not reported to the CHP. These confirm our intuition, that deer whistles reduce, but not eliminate, collisions with deer, and also that most collisions with deer go unreported to the CHP. The three collisions occurred with the three different types of deer whistles, one type per collision, so we can make no inference about the effectiveness of the different types of whistles. One of the original considerations of this project was to test the effectiveness of different types of deer whistles, but this project has insufficient data to achieve this.

Conclusions

From a statistical standpoint, deer whistles work. None of the 1648 vehicles listed in our database whose owners received a deer whistle from us were involved in any reported collisions with deer, over a period of two years. Statistical analysis by two different methods indicates the level of confidence that the deer whistles are responsible for this decrease in collisions is about 99.6%.

Some cautions should be noted. Everyone who drives in deer country knows that there is an element of luck involved in hitting or avoiding a deer, regardless of the equipment or amount of driver caution. Statistically, there are so few collisions with deer that a small change in the number of deer collisions would greatly alter the outcome.

Experience indicates that it is not reasonable to claim that deer whistles prevent all collisions with deer, but the results of this program indicate that they probably reduce the collision rate by a certain amount, although that number is presently not known. Lastly, there are many factors present that affect the results, and that are neither controlled nor measured.

However, the successful results for the vehicles that have our deer whistles have far exceeded our expectations. From a review of literature on the subject, this program appears to be the only large-scale project of its kind, and one of the very few to address the area-wide deer collision problem.

Lastly, it should be emphasized that all drivers in deer country must be alert and cautious, whether the vehicle is fitted with deer whistles or not. We have encountered the attitude of some drivers that deer whistles are a protective armor that allows a driver to ignore the possibility of collisions with animals.

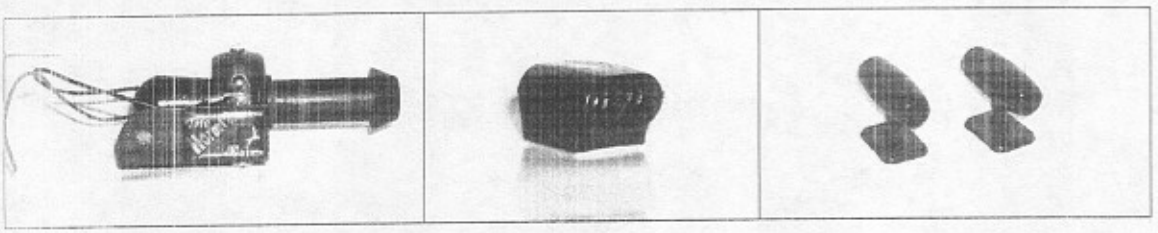
Further Activities

The installation of deer whistles is normally considered a private activity, to be done by individual vehicle owners. We feel quite justified in conducting one project that is, in effect, an observational experiment, but we will not continue supplying deer whistles for private vehicles past this one program. We do have a responsibility to distribute information about the results of the project, and to encourage the use of deer whistles. We anticipate sending copies of the final report to selected agencies and jurisdictions, insurance companies, and other interested parties.

Appendix

LOCATION OF THE PROJECT

LOCATION OF THE PROJECT



DEER WHISTLES

LEFT TO RIGHT: HORNET ELECTRONIC DEER WHISTLE, A SINGLE-PIECE SAVE-A-DEER AIR-ACTUATED WHISTLE, A TWO-WHISTLE SET OF WAGAN AIR-ACTUATED DEER WHISTLES

FREE

DEER WHISTLES

Air-actuated and electronic

FOR VEHICLES THAT TRAVEL IN MODOC COUNTY

AVOID COLLISIONS WITH DEER

The Modoc County Road Department is offering free deer whistles, in its program to reduce vehicle collisions with animals, funded by the State of California Office of Traffic Safety.

Pick up your free deer whistles at the Modoc County Road Department, 202 West Fourth Street, Alturas, from 8:00 a.m. to 12:00 noon and 1:00 p.m. to 5:00 p.m. Monday through Friday, except holidays.

Flex your POWER℠

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Quantities are limited.
For further information
please telephone
233-6403

NEWSPAPER ADVERTISEMENT

Whistle No	Date	Last Name	First Name	License Plate No	Type of Whistle
1	6/7/2001	Riley	Robert	3WMX153	Wagan
2	6/7/2001	Begany	Roger	2B12190	Hornet
3	6/7/2001	Morgan	Kathy	4HCW426	Hornet
4	6/7/2001	Begany	Roger	2MWH903	Hornet
5	6/7/2001	Williams	Brad	5C12411	Save-A-Deer
6	6/7/2001	Williams	Brad	5C12411	Save-A-Deer
7	6/7/2001	Williams	Kelly	4FPV929	Save-A-Deer
8	6/7/2001	Philpott	Susie	3LQY870	Wagan
9	6/7/2001	Philpott	Susie	4H02713	Wagan
10	6/7/2001	Sandstrom	Melinda	6K20704	Wagan

DEER WHISTLE DISTRIBUTION DATA FORMAT

DO THESE DEER WHISTLES WORK?

Do you think the deer whistle saved you from hitting a deer?

Did you hit a deer anyway with a deer whistle installed on the vehicle?

PLEASE LET US KNOW:

Telephone: (530) 233-6403

Fax: (530) 233-3132

Address: Modoc County Road Department
202 West Fourth Street
Alturas, CA 96101

e-mail: ttracy@hdo.net

The Modoc County Road Department has received a grant to purchase and distribute deer whistles. The purpose of the grant, funded by the State of California Office of Traffic Safety, is to reduce collisions with animals, the greatest single cause of traffic accidents in Modoc County.

Several types of deer whistles are available, including electronic and air-actuated. The deer whistles will be free to recipients, but supplies will be limited. You can install more than one whistle, and more than one type of whistle on your vehicle. You install the deer whistle – we don't want to be working on your car. We will ask you your name and the license plate number of the vehicle you will install the deer whistle on, so we can track accidents and determine the effectiveness of the deer whistles.

AN ANALYSIS OF COST SAVINGS FROM TRAFFIC CRASHES PREVENTED UNDER THE PROGRAM TO REDUCE COLLISIONS WITH ANIMALS DURING THE PERIOD JANUARY 1, 2000, TO DECEMBER 31, 2002

CRASH TYPE	NUMBER OF CRASHES IN 2000* UNITED STATES	PERCENTAGE OF TOTAL CRASHES UNITED STATES	UNIT COST PER CRASH * UNITED STATES	EXPECTED NUMBER OF CRASHES PREVENTED MODOC COUNTY	EXPECTED COST OF CRASHES PREVENTED MODOC COUNTY
PDO	13,487,355	82.4812	$2,532	4.7493	$12,025
INJURY	2,827,277	17.2901	$45,932	0.9956	$45,730
FATAL	37,409	0.2288	$1,092,464	0.0132	$14,420
TOTAL	16,352,041	100		5.7580	$72,175

* Data from *The Economic Impact of Motor Vehicle Crashes 2000,* Blincoe, *et. al.*, National Highway Traffic Safety Administration, May 2002