DEER WHISTLES

There are a number of deer-vehicle crash (DVC) countermeasure devices sold to the general public that indicate they use "ultrasonic" noise to alert deer to the approach of a vehicle. These devices are commonly referred to as "deer whistles". Deer whistles have existed for a relatively long time (they were introduced in the late 1970s) and have even been distributed to drivers by some insurance companies for a reduced fee rate.

The primary objective of deer whistle devices is to alert a deer by producing a noise that draws their attention and reduces the risk of a DVC occurring (e.g., the deer freezes or flees). The manufacturers of these devices, for the most part, indicate that they produce ultrasonic noise in the range of 16 to 20 kilohertz (kHz). The devices reportedly produce this noise (which is outside the range of human hearing) as air passes through them. Typically, the manufacturers indicate the device operates on vehicles traveling 30 miles per hour (mph) or faster, and that the ultrasonic noise can be heard up to about a 1/4-mile. More recently, some noise-related devices have also been introduced, but are not air-activated. These devices are electronically powered and can be designed to produce the manufacturer specified level of noise at any vehicle speed. No studies or independent analysis of just electronic devices was found in the literature. A few studies, however, were discovered that considered the effectiveness of air-activated deer whistles and the hearing capabilities of deer (*1*, *2*, *3*, *4*, *5*, *6*, *7*). One of these studies also included electronic whistles, but the possible difference in effectiveness between them and air-activated whistles was not the focus of the investigation (*3*). These studies are discussed in the following paragraphs.

Literature Summary

The DVC reduction effectiveness of deer whistles has not been vigorously studied. Much of the literature reviewed consisted of non-scientifically defined anecdotal evidence as its basis for an effectiveness discussion. However, there have been some very specific declarations made about the DVC reduction effectiveness of deer whistles based on this type of approach. The scientific validity of this type of claim was considered questionable by the authors of this toolbox and they are not repeated.

Another method that has been used to evaluate the effectiveness of deer whistles appears to include the comparison of safety or crash data for a group of governmental agency vehicles (typically one to several hundred) before and after the device was installed. Typically, the time period considered before and after the devices were installed was months, years, or not documented. A general discussion of the results from these types of studies is briefly described in the following text. The primary weakness of this research is typically the small sample size, length of time period considered, and general lack of control comparison.

Published documents that focus on the effectiveness of deer whistles and also describe the study design and results were found in only a few instances. These studies are discussed in this summary. An analysis that considers the hearing capabilities of white-tailed deer is also summarized.

Before-and-After Evaluations

Some before-and-after studies have attempted to evaluate the effectiveness of air-activated deer whistles. The details of few of these studies have been properly documented. One study in Onodaga County, New York was documented (*1*). The Sheriff's Department in the county mounted deer whistles on 55 patrol cars (*1*). The documentation for the devices indicated that they were supposed to activate at vehicle speeds above 30 mph and be heard by animals at a distance of 400 yards (*1*). In an October/November 1988 newsletter article about the devices it was reported that only two patrol cars had struck deer since 1986 and that five others had sustained minor damage avoiding collisions with deer (*1*). Before the installation of the devices the county sheriff's department experienced about 10 DVCs each year (*1*). It was suggested by the author of the newsletter article that the whistles need to be checked often so that they did not become plugged, and that extra caution needs to be used in areas with vertical and horizontal roadway curvature because the noise might not propagate well in these areas.

The results from an analysis of the fleet vehicle whistle experience at the Idaho National Engineering and Environmental Laboratory have also been documented (*2*). This article

indicated that the laboratory fleet experienced no crashes during the five years after the device installation, but had an average of 17 per year before the devices were installed (*2*). The authors of this study also acknowledged that conflicting results had been produced by studies that focused on the effectiveness of these devices (*2*). The typical variability in the number of DVCs experienced by the governmental agencies and/or the general public was not addressed in either document.

On a larger scale, several different types of air-activated and electronic deer whistles were provided free of charge to 1,648 drivers of Modoc County, California (*3*). The whistles were distributed to people that responded to the newspaper advertisement, and their license plate numbers recorded (*3*). The drivers were responsible for whistle installation and maintenance, but the adequacy of these activities was not confirmed (*3*). From 1998 to 2000 it was indicated that about 23 percent of the reported collisions in this county were animal related (primarily mule deer) (*3*).

A statistical analysis was used to compare the 2001 and 2002 actual and expected number of DVCs for the 1,648 vehicles with whistles (*3*). Assuming that every vehicle in the county had an equal chance of being involved in a DVC, it was determined that the vehicles with whistles should have experienced a total of six DVCs (*3*). However, no DVCs actually occurred (*3*). This difference was determined to be statistically significant by the authors of this report, and they believe the whistles were the reason for this reduction (*3*). No discussion of the natural variability in DVCs in the area was addressed. A similar approach was taken to compare the DVC involvement rate of vehicles with and without whistles to the crash patterns that occurred before the whistles were distributed. Not surprisingly, the same conclusion was reached with respect to the effectiveness of the whistles (*3*).

The authors of the Modoc County study document, however, recognized that several factors weakened the validity of these results (*3*). These factors include the small number of DVCs that occurred during the two years of the study and the impact of characteristics outside the control of the researchers (e.g., severity of the winter and number of mountain

lions) (*3*). Additional concerns with the results include the inherent assumption that all vehicles have the same probability of being involved in a DVC, and that the whistles were all installed and maintained adequately throughout the study time period. It might also be argued that drivers who take advantage free whistles are especially aware of the DVC problem, and this could impact the results of this study. These confounding factors limit the validity, transferability, and usability of the results from this study (despite the large number of vehicles involved).

In contrast, the Insurance Institute for Highway Safety also published a status report in which it reviewed at least two studies that appeared to produce the opposite result of those indicated above (*4*). First, an article from the mid-February 1993 *Farm Journal* was reviewed that stated the Ohio State Police, after installing deer whistles on their patrol vehicles, did not experience a DVC reduction (*4*). In addition, it was also stated that the Georgia Game and Fish Department had not observed, during hundreds of encounters, any deer response to vehicles with deer whistles installed (*4*).

Device Effectiveness

During January/February 1990, Romin and Dalton studied the response of mule deer to vehicle-mounted deer whistles (*5*). Two brands of air-activated whistles were separately mounted to the front of a truck and their impact evaluated on wild mule deer. These whistles had what were considered to be typical manufacturer specifications (i.e. it was expected they would produce an ultrasonic sound of 16 to 20 kHz at vehicle speeds greater than 30 mph, and that could be heard by deer at or closer than 1/4-mile or 400 yards). The study was conducted along a 6 mile segment of dirt roadway in the Gordon Creek Wildlife Management Area of Carbon County, Utah (a winter range for mule deer). The impact of each whistle was tested by driving the test truck in both directions at 40 mph past groups of deer within 62 feet of the roadway. The first pass drive by of the vehicle was completed without whistles to acclimate the deer to the truck noise, and to get a better idea of how the responses changed with the addition of the whistle. The second drive by of the vehicle, in the opposite direction, was competed with the whistles. The response of the deer, and their distance to the vehicle was recorded for each pass. A

response by a group of deer was considered equal to one of them lifting its head, changing its orientation, running away from the truck, or running toward the truck (*5*).

A total of 300 observations were made on 150 deer groups as part of this study (*5*). As indicated, half of these observations were for the vehicle with no whistle, and the other 150 observations were split almost equally between the two whistle brands being evaluated (i.e., one was tested 76 times and the other 74 times). Table 1 shows the observed deer response to the truck with and without the whistles. Overall, approximately 61 and 69 percent of the deer did not respond to the vehicle either with or without the whistle mounted, respectively. In other words, fewer deer responded to the vehicle with the whistle (31 percent of the total) than to the vehicle without the whistle (39 percent of the total). The expectation would be that the deer would acclimate themselves to the vehicles and the difference in reaction would be the result of the whistle if the deer could hear it.

TABLE 1 Whistle and No Whistle Responses of Free-Roaming Mule Deer Groups (*5*)

	Behavior				
	No Response	**Lifted Head**	**Changed Orientation**	**Ran Away**	**Ran Toward**
No Whistle	91	31	5	18	5
Whistle	103	28	3	9	7

The number of responses from deer groups within 6 feet of the roadway is shown in Table 2 (*5*). The authors more closely considered these deer groups because it was speculated that they would have the most probability of causing a collision. The response/no response results for the vehicle passes with and without the whistle follow a pattern similar to those shown in Table 1 for the entire sample. In general there were fewer responses to the vehicle with the whistle than without.

The authors of this study concluded that the mule deer response to a vehicle without a whistle was not statistically different than those with a whistle (*5*). However, the study

TABLE 2 Mule Deer Response Observation within 6 Feet of the Vehicle (*5*)

	Behavior	
	Response	**No Response**
Without whistle	18	12
With Whistle	14	14

did not test whether the mule deer can hear within the specified noise range of the devices, or if the devices were actually making that specified noise.

Deer Auditory Capability Study

The effect of deer whistles on the number of DVCs is dependent upon the ability of deer to physically hear and respond to the sound produced by the devices. As previously mentioned, the advertised range of the sound produced by air-activated deer whistles is typically 16 to 20 kHz at speeds at or above 30 mph. In 1993, the Insurance Institute for Highway Safety (IIHS) summarized a number of studies that considered the auditory capabilities of deer (*4*). The article stated that wildlife biologists at the University of Georgia had found that neither deer nor humans could hear these ultrasonic sounds, and that whistles blown by mouth produced no response from penned deer. The IIHS summary also indicated that University of Wisconsin researchers had found that the whistles produced low-pitch and ultrasonic sounds at 30 to 70 mph, but that no response from deer was observed. Published documentation of these studies that describes their experimental design and how the deer response was measured were not found.

Fortunately, a document was also found that included a description of some work that compared deer hearing capabilities to the sound made by typical deer whistles (*6*). The physical characteristics and impact on sound projection of the roadway environment (e.g., vehicle noise and lessening of sound through air) were also investigated (*6*). Scheifele, et al. tested six deer whistle devices in the laboratory and/or the field. All the devices were generally advertised as "ultrasonic" (i.e., producing a sound with a frequency greater than 20 khz) devices, but the packages of two devices also indicate that they produced sound frequencies between 16 and 20 kHz sound when mounted on vehicles driven at 30 mph or more (*6*). The sound made by the other whistles was only described as high

frequency (*6*). It was stated that the devices could be heard by deer that were anywhere from 62 feet to 1.2 miles (100 meters to 2 kilometers) away from the roadway. The objective of the study was to determine the most commonly produced frequency of the deer whistles and compare them to the reported hearing capabilities of deer. The relationship between the roadway environment and the noise produced by the devices at certain distances was also investigated (*6*).

All six whistles were tested in the laboratory and the two that produced the highest intensity sound in the laboratory were then tested in the field (*6*). The laboratory tests included the forcing of air through the six whistles until a strong sound was "heard" and measured (*6*). In the field, the two devices that produced the highest intensity sound were then mounted on two cars that were driven at 30 mph, 35 mph, 40 mph, and 45 mph. The sound intensity of the whistles was recorded 10 times for each speed from a single point on the closed roadway. In both cases, the ambient room and roadway (without the vehicle) noises were first measured. The measurement results included the most common sound frequency and intensity, and the variation in the signal at each speed (*6*). Typical vehicle and roadway noise levels were estimated from previous research.

Overall, the hearing capabilities of deer have not been studied to any great extent. However, past research used by Scheifele, et al. for comparison purposes indicated that the "range of greatest hearing sensitivity" for deer is between two and six kHz (*6, 7*). In the Scheifele, et al. study deer whistle effectiveness was determined by comparing the most commonly measured frequency and intensity with this deer threshold hearing range. Overall, it was found that the primary operational frequency produced by the different whistle designs was 3.3 kHz (closed end design) and 12 kHz (open end design) (*6*). In the latter case, the results were found to vary and also depend on how hard the air was forced through the device. Clearly, the results of the laboratory tests do not match the frequencies typically advertised as those produced by the deer whistles. The 16 to 20 kHz sound range advertised for two of the air-activated whistles is also outside the "best" range of deer hearing capabilities.

Scheifele, et al. concluded that the harmonics of the devices they studied were not likely to be heard by deer unless they were broadcast at very high intensities (*6*). The 12 khz whistles produce a sound that is outside the "best" hearing range of deer, and the average sound pressure levels for the 3.3 kHz whistles was also "totally lost" within the noise past research has indicated is produced by a vehicle on the roadway at 40 mph (*6*). In addition, a frequency of 3.3 kHz should also be heard by both the deer and humans, but in these tests the drivers did not notice the whistle noise. The sound from the devices also has to be heard far enough away from the vehicle to allow a proper reaction by the deer.

The results from Scheifele, et al. show that the range (based on research-based assumptions of transmission loss and ambient roadway noise levels) of a device operating at 3.3 kHz would probably reach a "significant warning distance" equal to the maximum they considered (i.e., 1.3 miles). This assumes, however, that the deer can hear and differentiate the device alert sound from the others that exist (e.g., vehicle roadway noise (see above) and wind). It was indicated, for example, that deer favor low frequency signals more than ultrasonic noise, and that the wavelength of signals that impact animals should be at least two to four times their body size (*6*). The 3.3 kHz signal measured had a wavelength of only about 4 inches (*6*). Deer will also typically focus on the closest sound, but Scheifele, et al. indicate that very little noise normally exists in the one to four kHz range in the wild, so the use of a 3.3 kHz device could be a good level to be heard by deer. Overall, it appears that the physical characteristics of the roadways limit the capabilities of deer whistles as alert devices. In addition, the researchers also indicate that there is a likelihood that the deer that feed near roadways will habituate to both the sound of the vehicles and that of the alert devices if they are heard (*6*).

Conclusions

The DVC reduction effectiveness of air-activated deer whistles has been investigated through the use of non-scientific before-and-after studies and some documented research into the hearing capabilities of deer. In general, the relatively poor design and/or documentation of the before-and-after studies (e.g., sample size) have produced dramatically conflicting results. No conclusions can be drawn from these studies as a

whole, and better designs and documentation are recommended for future studies of this nature. A small amount of documented/published research has been completed in the area of deer auditory capabilities and their reaction to air-activated whistles. For the most part, it has been found that the range of hearing sensitivity for deer is two to six kHz, and only some whistles apparently make sound within that range. It has also been generally concluded that deer did not react to vehicle-mounted air-activated deer whistles, and that hearing the sound from these devices might be difficult when combined with typical vehicle roadway noise levels. The ability of whistles to produce the advertised level of sound at an adequate distance within the typical environment of a roadway has been questioned. Additional scientifically defined and designed research focused on the effectiveness of air-activated deer whistles and similar non-air-activated devices is recommended. A current concern is also the impact the installation of these devices (which may or may not work) on vehicles may have on the alertness of drivers (i.e., Do they provide an unproven sense of security?).

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