Chapter 25

USE OF REFLECTORS AND AUDITORY DETERRENTS TO PREVENT WILDLIFE-VEHICLE COLLISIONS

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SUMMARY

Roads present an unnatural and confusing environment for wildlife and humans alike. Wildlife reflectors and auditory deterrents aim to modify the behaviour of wildlife on or adjacent to the road. Reflectors are designed to redirect the light from oncoming vehicles into the adjacent verge, while auditory deterrents are designed to cause pain, irritation or masking of other biologically relevant noises. Both techniques attempt to warn animals and discourage them from attempting to cross roads in front of approaching vehicles, with the ultimate goal of reducing the rate of wildlife-vehicle collisions (WVC).

25.1 Most studies of the effectiveness of wildlife warning reflectors have been poorly designed and are inconclusive.

25.2 The colour and intensity of light produced by reflectors may not elicit a response in the target species.

25.3 Wildlife warning reflectors are unlikely to alter animal behaviour and prevent WVC.

25.4 Auditory deterrents, typically mounted to the front of vehicles, appear ineffective at modifying animal behaviour and are unlikely to significantly reduce the rate of WVC.

Wildlife reflectors and auditory deterrents may add to the complexity of the roadway environment without achieving the intended effect of preventing WVC. Given the unproven effectiveness of these techniques and the potential negative consequences of using the devices, the implementation of wildlife warning reflectors and auditory deterrents is not recommended.
INTRODUCTION

Wildlife warning reflectors and vehicle-mounted auditory deterrents (e.g. wildlife warning whistles) are intended to reduce WVC with primarily deer species and other large herbivores by modifying their behaviour. Manufacturers claim that the reflectors deter animals from attempting road crossings by altering and deflecting light from oncoming vehicle headlights across the road and into the roadside verge to provide a visual warning (Strieter Corp., unpublished instruction manual: 3). Reflectors are mounted on posts along roadsides and consist of a housing with reflective mirrors, which redirect light through coloured lenses, usually red (Fig. 25.1). The reflectors are staggered on both sides of the road, and the headlights of approaching vehicles shine on the reflectors, and light travels diagonally across the road to the next reflector in the installation (Fig. 25.2). Reflectors may also be added on the backs of the posts to direct additional light away from the roadway.

Figure 25.1 Three different types of roadside reflectors. Source: Photographs by Marcel Huijser.

Light from approaching vehicle strike the reflector mounted on a post, directing light across the road. The suggested reason this might be effective is that animals may be disturbed by the light and are less likely to proceed toward the road. Studies have not yet provided evidence for this. Reflectors are spaced so that light reflects through a brightening arc and will, to some extent, cover the whole of the roadside. Light would be perceived as a series of one or more flashes.

Figure 25.2 There is currently no evidence that roadside reflectors effectively reduce wildlife–vehicle collisions. This schematic shows the theoretical application of roadside reflectors, where light from oncoming vehicles are reflected across the road (and possibly onto the opposite reflectors) and into both verges (although light only shown on one verge to improve clarity), thereby discouraging wildlife from attempting to cross the road. Source: Reproduced with permission of Scott Watson.
Wildlife warning whistles are mounted to the front of the vehicle and emit noise as the vehicle is driven. Invented in 1979 in Austria (Romin & Dalton 1992), they are inexpensive, readily available and widely used in North America and Europe for deer and in Australia for kangaroos. More recently, battery-operated devices have been developed that produce and propagate noises, even when the vehicle is stationary.

Wildlife warning reflectors and auditory deterrents are marketed as a proven and humane technique for reducing WVC (e.g. www.striecer-lite.com, www.shurco.com.au). Planners find it difficult to decide whether reflectors and/or whistles are a good investment for reducing the risk of WVC. The aim of this chapter is to raise awareness of past experiences with these devices, possible explanations for why reflectors and whistles remain unproven and insights into the limitations of altering the behaviour of wildlife in the immediate vicinity of roads.

LESSONS

25.1 Most studies of the effectiveness of wildlife warning reflectors have been poorly designed and are inconclusive

Studies of the effectiveness of a range of wildlife warning reflector models have produced variable results (Gilbert 1982; Armstrong 1992; Reeve & Anderson 1993; Paiko & Kovach 1996; Gulen et al. 2006). Researchers have used a diversity of methods with various levels of scientific validity to study the effectiveness of reflectors (D’Angelo et al. 2005). However, there remains a limited understanding of reflector efficacy. Most reflector evaluations were based on counts of WVC within test sections that were either (i) pre- and post-installation of reflectors (Ingebirtksen & Ludwig 1986; Waring et al. 1991; Paiko & Kovach 1996); (ii) when reflectors were covered versus uncovered (Schauer & Penland 1983; Woodham 1991; Armstrong 1992); or (iii) within sections of roads with reflectors as compared to adjacent control sections without reflectors (Reeve & Anderson 1993; Sielecki 2001). Such methods failed to consider changes in animal densities, seasonal movements or traffic patterns. Little is known about how animals react to reflector activation or if individual animals become habituated to the devices over time. Beyond differences in experimental design, comparison of results among different reflector studies is further confounded by the variety of reflector models tested and the distinct spectral properties of the different devices (D’Angelo et al. 2005).

Studies were also often limited by sample size and poor experimental design. In most cases, animal carcasses along roads were counted, but rarely were they quality controls such as video surveillance of test sections, driver surveys or accident reports used to account for collisions where animals are left on the roadside. Most reflector studies also provided little data on the behaviour of free-ranging animals to reflector activation, a significant omission, given that these behavioural reactions constitute the basis for the purported effectiveness of reflectors.

25.2 The colour and intensity of light produced by reflectors may not elicit a response in the target species

Examinations of the visual abilities in white-tailed deer and fawn deer have shown that peak sensitivity of colour vision is well below the long wavelength of red (Jacobs et al. 1994), which is the most commonly marketed colour of wildlife warning reflectors. Most marsupials have dichromatic vision, lacking sensitivity to long wavelengths (Fig. 18.2) (Hemmi et al. 2000; Deeb et al. 2003), which would likely render red reflectors ineffective in deterring collisions with these species as well.

The effectiveness of four wildlife warning reflector lens colours (blue-green, amber, red and white) was evaluated for altering the behaviour of white-tailed deer along roads (D’Angelo et al. 2006). Based on characteristics of deer colour vision and the assumption that reflectors are effective, they hypothesised that short-wavelength (i.e. blue-green) reflector lens colours would be the most effective and long-wavelength (i.e. red) lens colours would be the least effective for preventing deer–vehicle collisions. The experiment demonstrated nearly opposite results. The highest level of deer–vehicle collision risk, based on deer behaviour along roadways, was observed during the blue-green reflector treatments with slightly lower levels of risk during the amber, red and white reflector treatments, in respective order of decreased risk. These results suggest that negative responses by animals may directly increase with greater sensitivity to different colours of light from reflectors.

Evidence for animals with nocturnal visual systems suggests that the rapidity of their visual adaptation from darkness to abrupt increases in light (e.g. vehicle headlights) may be considerably slower than that of daylight-active species like humans (Ali & Klyne 1985).
A possible explanation for the increase in WVC in areas where reflectors were installed in some studies may be that light from reflectors, in combination with vehicle headlights, overwhelmed the animals' visual system.

### 25.3 Wildlife warning reflectors are unlikely to alter animal behaviour and prevent WVC

Few descriptions from the scientific literature exist that describe animal behaviour in direct interaction with vehicles when reflectors are activated. Observations of the response of white-tailed deer to vehicles suggest that deer tend to avoid crossing roads in the presence of vehicles, regardless of whether reflectors are in place (D'Angelo et al. 2006). Likewise, Waring et al. (1991) observed that greater than 70% of crossings by white-tailed deer were completed without a deer–vehicle interaction on a two-lane highway with regular traffic.

Follows quickly became habituated to repeatedly occurring light reflections from a red WEGU reflector (Walter Drilling KG, Kassel, Germany) placed directly in front of a bait site (Ujvari et al. 1998). During the first experimental night, follow deer fled from the stimulus in 99% of cases but exhibited increasing indifference to reflections over the remaining 16 nights. This was interpreted as habituation of the deer to the stimulus. Similarly, captive red kangaroos and red-necked wallabies showed a negligible behavioral response to a simulated roadway environment with wildlife warning reflectors activated by a series of lights (Ramp & Croft 2006).

The primary intent of using wildlife warning reflectors is to elicit a response from an animal in the immediate vicinity of moving vehicles. Behavioural responses to stimuli may differ among species and individuals depending on several factors (e.g. number of animals in a group, season, roadside characteristics, number of traffic lanes, traffic volume, traffic speed). Two possible behavioural responses to reflectors could be directional flight or vigilance (i.e. stop and observe). Depending on the location of the animal relative to the roadway at the time of the behavioural response and their direction of travel and also based on the reaction of the animal, a WVC could either be averted or occur. Given the unpredictable behaviour of wildlife under various roadway conditions, the theoretical basis for using wildlife warning reflectors and similar devices to prevent WVC is questionable. Therefore, in the interest of motorist safety, we recommend that planners do not consider the use of wildlife warning reflectors.

### 25.4 Auditory deterrents are ineffective at modifying the behaviour of wildlife and unlikely to reduce the rate of WVC

Auditory deterrents are used in a wide range of situations as a non-lethal method to modify animal behaviour and are promoted as humane, inexpensive, scientifically proven and easy to use (Bomford & O'Brien 1990; Bender 2001). However, there is no published scientific evidence to indicate they are effective at modifying animal behaviour or reducing the rate of WVC (Romin & Dalton 1992; Ujvari et al. 1998; Bender 2001; Scheiffele et al. 2003; Valitski et al. 2009).

There are a number of compelling reasons why vehicle-mounted auditory deterrent systems are unlikely to ever be effective. First, most whistles are designed (and purported) to emit noise in the 16–25 kHz range (i.e. ultrasonic), but most tests have demonstrated that their actual performance differs from that stated by manufacturers (e.g. Bender 2001: Scheiffele et al. 2003). Second, sound attenuates (i.e. becomes quieter) with increasing distance from the source, and higher-frequency sounds attenuate more quickly than lower frequencies. Therefore, the effective distance of high-frequency ultrasonic noises generated by whistles or other vehicle-mounted devices is unlikely to extend far enough in front of fast-moving vehicles to give the animal time to respond and move away from the road (Bender 2001; Scheiffele et al. 2003). In addition, environmental conditions (e.g. weather, topography, vegetation) and road design (e.g. bends or cuttings) will further reduce the effective distance of ultrasonic deterrents. This is potentially problematic, because they are designed to work on the premise that animals are alerted with sufficient time to respond and move away, rather than be startled and move onto the road in front of oncoming vehicles. Third, the designed frequency spectrum of the generated noise will be compromised by other engine and road noises, potentially masking the high-frequency sounds that are purported to affect animal behaviour. Fourth, animals typically habituate quickly to noises (Bomford & O'Brien 1990), and the response to vehicle-mounted auditory deterrents should be no different, and unless there is an associated negative stimulus, animals will habituate to the whistles. Finally, whistles mounted to the front of vehicles are easily blocked by insects, thus not producing any sound at all and potentially giving drivers a false sense of protection.
Conclusions

The road-crossing success of animals in localised areas may be impacted by factors such as vehicle speed, traffic volume and patterns, vehicle types, motorist awareness of wildlife, weather conditions, ambient and vehicle-produced light and noise levels, characteristics of the habitat–roadway interface and mitigation measures (D’Angelo et al. 2005). Irrespective of the unproven effectiveness of reflectors or questions of transmission of light (intensity and wavelength) from reflectors and noise from whistles, attempting to affect the perception of animals in the immediate vicinity of the roadway is a poor strategy. The myriad of stimuli already present on vehicles and along roads do not prevent animals from crossing roads in the presence of moving vehicles. For these reasons, as well as logistical challenges of delivery in the field, approaches using predator sounds and deterrents feeding are similarly unlikely to be effective across large spatial scales. Until effective science-based strategies become available, management efforts should focus on: (i) avoiding the construction of new roads in areas with large-bodied animals; (ii) using fencing and wildlife crossing structures (Chapters 20 and 21) to prevent access by wildlife to the roadway and facilitate connectivity; (iii) proper population management programmes; (iv) controlling roadside vegetation to minimise its attractiveness to wildlife and to maximise visibility for motorists (Chapter 46); (v) increasing motorist awareness of dangers associated with WVC; and (vi) minimisation of unnecessary stimuli in the roadway environment that may increase confusion of wildlife. Our understanding of animal senses continues to expand and be refined. Future development of animal deterrent strategies should be guided by our knowledge of animal senses and their behaviours in roadway environments and be subject to thorough independent testing prior to deployment.

Further Reading

Blackwell and Seamans (2008): Vehicles present a complex array of stimuli that can confuse wildlife along the road verge. This research demonstrated that specific vehicle headlight designs with light transmissions that better complemented the peak visual capabilities of white-tailed deer at night yielded an earlier flight by deer from an approaching vehicle.

D’Angelo et al. (2006): An in-depth examination of white-tailed deer behaviour in close proximity to roads during activation of wildlife reflectors by vehicles which showed that wildlife warning reflectors did not alter deer behaviour such that deer–vehicle collisions might be prevented.

Grandin and Johnson (2005): Presents unique perspectives about animal behaviours that result from the animal’s biology, evolution, and situational awareness. The lead author, Temple Grandin, is an animal scientist who uses her own experiences of living with autism to explain how animals perceive the world.

Bonford and O’Brien (1990): A detailed overview of the use of auditory deterrents for wildlife, including a summary of use and effectiveness in different situations, the theoretical basis for their use and the many problems associated with their deployment.

References


