Integrating conservation biology into the development of automated vehicle technology to reduce animal–vehicle collisions

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Abstract
Every year, hundreds of millions of animals die in collisions with cars. For some species, road strikes are a major cause of population declines, and reducing collisions is a conservation priority. We suggest that the emergence of automated vehicles will provide new opportunities for the use of computerized animal warning systems and variable speed zones in areas (and times) of high collision risk—but only if conservation biologists play a role in the development and implementation of these vehicles on the road.

KEYWORDS
driverless cars, road fatalities, roadkill, technology, wildlife

Animal–vehicle collisions are a common and costly issue worldwide. In the United States alone, millions of collisions with deer cause thousands of human casualties and more than six billion U.S. dollars in medical, property, and municipal damages each year (Huijser, Duffield, Clevenger, Ament, & McGowen, 2009). Though collisions with large mammals like ungulates are more likely to cause damage to vehicles, road strikes are a major conservation issue for many species, contributing to localized population declines and increasing extinction risk. Across southeast Queensland, for example, koala populations have diminished by up to 80% since 1996, and though disease is a major threat to the species in this region, more than a quarter of koala admissions to wildlife hospitals between 1997 and 2013 were of undiseased animals that had been struck by cars (Gonzalez-Astudillo, Allavena, McKinnon, Larkin, & Henning, 2017). Road strikes are a major contributor to the extirpation of the species in this region.

Road strikes can be mitigated with physical barriers such as fences, reductions in speed limits, and even by the implementation of Daylight Saving Time (Ellis et al., 2016). Roadside fencing is the most common and effective means of preventing animals from accessing roads, but can impede dispersal, foraging, or migration, so fences are often used in conjunction with crossing structures, which allow animals to move over or under the roads to access other parts of their home range. Together, these measures can reduce road strikes of large animals like deer by 80% or more (Rytwinski et al., 2016), substantially reducing human and animal casualties. However, even in wealthy, developed nations, fences can never be a universal solution because they are costly to maintain and simply cannot be erected everywhere they are needed. In developing nations, the expansion of transportation networks and urban centers often takes priority over biodiversity or conservation issues.

Despite these current challenges, we believe that the best potential for reducing animal–vehicle collisions is yet to come. Sometime in the next 10 years, fully automated vehicles will become available to the public, and by 2040 they are expected to be the norm. Automated vehicles will be able to obtain and respond to instantaneous updates on road conditions, weather, and speed limits with capabilities that exceed...
those of humans. What opportunities does this technology offer for reducing animal–vehicle collisions? The top priority for developers of automated vehicles is to improve driver and passenger safety, primarily by reducing collisions between vehicles caused by human error. Without pressure from conservation biologists, development of the technology to detect wildlife is likely to proceed only in the context of human health. Prestige companies such as Volvo, BMW, and Mercedes already use infrared cameras or radar in some vehicles to assist driver detection of animals on or near roads, though detection works best on large animals (like deer, moose, or kangaroos) and those unobscured by foliage. Inherently, the movements of wild animals are much more difficult to predict than those of humans, and detection of small animals like koalas—those unlikely to cause human casualties—will not be a major concern for manufacturers as long as automated vehicles are safer than human-driven versions.

Yet automated vehicles will be programmed to respond to speed limits, and likely with better consistency than human drivers. Animal–vehicle collisions are more likely to occur and to cause human and animal fatalities in high-speed zones (Langley, Higgins, & Herrin, 2006), so reducing speed limits could substantially reduce these losses. One widely considered option for roadkill mitigation is to impose variable speed limits, where speeds are reduced within those locations and times where collision risk is highest—namely, in roadkill hotspots during the hour after dusk, when mammals become active and their visibility to drivers begins to decline. Variable speed limits are already used to reduce collision risk with people in school zones, on congested freeways, and in inclement weather when—as in darkness—visibility is reduced and stopping distance extended. But getting drivers to adhere to speed limits is a major problem, and one that will not likely improve until driving is automated. Automated cars may reduce road strikes by adhering to laws and regulations already in place and will increase the value of variable speed limits to conservation efforts, but only if scientists and managers are part of their development. It is a real possibility that automated cars could be permitted higher speed limits than those driven by humans, because the industry is not considering their effect on wildlife—only considering the effect of wildlife on them.

Now is the time for biologists to collect data on road use by wildlife and make these known to those creating new road technologies and the laws that define their use so that, wherever possible, they can be integrated into automated vehicles from the beginning. To set appropriate variable speed limits, we need to quantify how vehicle speed affects the probability of collisions with wildlife and how this relationship is influenced by both road conditions (e.g., traffic flow, road width) and the biology of the species of interest (e.g., ecology, activity, and movement). Already, citizen science applications exist that could facilitate the collection of roadkill data (e.g., Olson et al., 2014), and the integration of these kinds of data into current and emergent technologies may be simple and relatively inexpensive. For example, GPS-based navigation apps like Google Maps could use roadkill or road-use data to warn drivers visually (i.e., color coding) and verbally as they approach high-risk conditions or even suggest alternative routes at particular times of day. These same data could inform the implementation of variable speed limits and road-use patterns by automated vehicles to prevent collisions with animals of all sizes. Though many innovators are keen to establish a “green” reputation, it is up to conservation biologists to ensure that the appropriate data are available and used in ways that reduce collisions with wildlife.

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