

Large-scale roadkill observation systems: Crowd-sourcing and hotspots mapping

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Large-extent Carcass and Accident Reporting Systems (CARS) have a fairly typical set of goals and methods, which help in standardizing methods of data collection, analysis, visualization, and use in decision-making across systems. Most systems around the world collect carcass and/or crash data to increase the understanding of degree and geography of ecological impact, risks to drivers, placement and effectiveness of mitigation structures. They commonly use a model for data collection of where, when, what (species/group), how, who (observer), why, and "other". This latter category could include road and habitat information, disposition and quality of carcass, and re-observation of carcass persistence. Most systems are web-based, including a relational database in the back-end. We report here on two major types of advancement in the collection and uses of CARS data.

The California Roadkill Observation System (CROS, <http://wildlifecrossing.net/california>) uses a form-based data entry system to record observations of carcasses that result from wildlife-vehicle collisions (WVC). Operating since 2009, it currently (Oct, 2017) contains >1,360 users and ~55,000 observations of >425 species of ground-dwelling vertebrates and birds, making it one of the most successful examples of crowd-sourced, roadkill data collection. The system can be used directly on a smart-phone screen, via a browser, which is a common approach today (e.g., Utah's reporting system, Olson et al., 2014). We have used data from this system to determine locations of high-density and/or statistically-significant clustering of WVC. These hotspots are potential locations for mitigation actions to reduce risks to drivers and wildlife. We have also used the data to inform two ecological studies: a state-wide study of mammal invasion and assessment of the ability of landscape "linkages" models to predict wildlife movement. Finally, volunteer-observers are carrying out studies to help us estimate total roadkill impact on species: collecting observations on transect roads and re-observing roadkill to estimate disappearance rates of carcasses from roads.

Our newer California Highway Incident Processing System (CHIPS) retrieves publicly-available crash reports from the California Highway Patrol (CHP) incident website and stores them in a local database. The user can query and tag incidents for involvement of animals, type of accident (e.g., collision vs. avoidance), and outcome of accidents for driver and animal. After 24 months (Feb, 2015 - Feb, 2017), there were >3 million total crash records in the system, with ~15-20 incidents/day involving mule deer. About 1/3 of these involved a vehicle swerving to avoid an animal in the road and subsequently crashing and approximately the same proportion involved the deer being injured and not killed outright. Accidents resulting from swerving were more likely to involve significant vehicle damage and injury than collisions with animals. Data from this system been used to estimate significance of WVC avoidance as a type of wildlife-human conflict that threatens driver safety, to estimate injury and property damage rates from all types of crashes involving different animal species and vehicles, and to compare crash hotspots with carcass hotspots. Because the system operates in real-time, we are also investigating the possibility of a continuously updated smart-phone application or Twitter feed to inform drivers and others of animal-related safety issues on highways.

The combination of crowd-sourced carcass data, agency-collected carcass data, and agency-reported crash data allows for a comprehensive and real-time view of human-wildlife conflict on roads. This means that the system provides decision-support from the individual driver scale to the state scale and from an historical perspective to what is happening right now.