

How demographic factors affect ground squirrel susceptibility to motor vehicle collisions

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Abstract

Roadkill or Motor Vehicle Collisions are highly studied amongst larger species. This research will solely focus on a smaller species, specifically Golden Mantled-Ground Squirrels (*Callospermophilus lateralis*) in Rocky Mountain Biological Laboratory (RMBL) Gothic, Colorado. Percentages of adult male, adult female, male juvenile, and female juvenile ground squirrels killed by vehicle collisions will be collected using a master list dating from 1995 to 2019 (24 years). In all, the data collected suggest that about 5% (1/20) of GMGS are found to be killed in vehicle collision. Adult males were killed in vehicle collisions more often than adult females (Figure 1).

Introduction

Vehicle collisions with wildlife are a major public safety concern, as 5% of collisions result in human injuries and vehicle repair costs an average of 8.4 billion US Dollars. . However, vehicle collisions are also deadly for wildlife: Around 1 million vertebrates are killed daily from vehicle collisions (Ouzounis, et al. 2014). Wildlife populations may also become isolated due to fear of crossing the roads. This can lead to inbreeding and prevent gene flow between populations. . The reduction in wildlife landscape/habitats continues as humans progress their roads and infrastructure. Factors such as fear, inbreeding, and human progression in roads and infrastructure can affect both small and large species, but the vast majority of studies have only been conducted on larger species. This research will solely focus on a smaller species of mammal, specifically the Golden Mantled-Ground Squirrels (*Callospermophilus lateralis*)) in Gothic, Colorado. GMGS live in a terrestrial environment in underground burrows at high elevations throughout western North America. On average, they have a lifespan of about 5-7 years. Female GMGS tend to be more territorial, while male GMGS tend to move frequently to find mates (McKeever 1964). They exhibit a scramble competition mating system, in which males cover large areas to locate and mate with females they encounter. Males are not sexually selective, and those who move farther and mate with as many females as possible generally have the most reproductive success (Schwagmeyer & Brown 1983). Juvenile GMGS show sex-biased dispersal, in that nearly all-male pups disperse, while only some females do (Jesmer, 2011). As far as their annual cycle, GMGS breed in the spring, pups/kits emerge from their natal burrow around June/July, and then juveniles disperse in the summer (McKeever 1964). GMGS are abundant at RMBL, where they have regularly been killed by vehicle collisions on the country road that runs through the lab.

My objective was to determine if demographic factors - age and sex - affect which squirrels are killed by vehicle collisions. When taking their biology and life-history into consideration, I hypothesize that male (adult or juvenile) GMGS are more susceptible to motor vehicle collisions than females (adult or juvenile) because they move around more than females since females are territorial they are less likely to explore their area and move around. Specifically, I expect that a higher proportion of male juveniles will have vehicle collisions than

female juveniles, because male-biased dispersal makes it more likely that they will cross the road and encounter vehicles. In addition, I expect that a higher proportion of adult males will have vehicle collisions than female adults, because adult males cover large areas to locate females, particularly during the breeding season. Finally, I expect that a higher proportion of juvenile squirrels will encounter vehicle collisions than adult squirrels, because they disperse away from their natal burrows into unknown areas.

Methods

Data was collected using an annual master list of GMGS at the Rocky Mountain Biological Lab dating from 1995 to 2019 (approximately 24 years). Each master list includes unique identification numbers for each individual. For example, “19/407” is a resident 2-year-old GMGS, with the number “19” on the individual’s left ear and “407” on the right ear. The master list also includes each individual’s age, sex, and cause of death (if any/known). These identification numbers are given to 1) faster identify an individual and 2) to keep track and record their lifespan at RMBL. These ear tags are pierced when they are caught in trapping cages that are baited with peanut butter and seeds. In addition to ear tags, for each summer that GMGS are caught, they also have symbol dye marks on their bodies to also faster identify them from a distance. When collecting this data for each year the number of adult males, adult females, juvenile males, and juvenile females were tallied on paper and then put into Google Sheets file. In addition, the number of roadkill for female and male juvenile and adult GMGS were counted and also put into the same Google Sheets file. When the Google Sheets was filled out completely categorized by year, sex, and age, a function was created to produce percentages for each category. Finally, since all the percentages for these categories were very close in values, a chi-squared test was used to determine if they were significantly different or not.

Results

In all, the data collected suggest that about 5% (1/20) of GMGS are found to be killed in vehicle collision. Adult males were killed in vehicle collisions more often than adult females (Figure 1). However, this result was not statistically significant (X^2 (df = 1, N = 529) = 0.02569, p = 0.61227, p > 0.05). Juvenile males were killed in vehicle collisions more often than juvenile females (Figure 1). However, this result was not statistically significant (X^2 (df = 1, N = 805) = 0.09199, p = 0.337501, p > 0.05). Adults overall were killed in vehicle collisions more often than juveniles (Figure 1). However, this result was not statistically significant (X^2 (df = 1, N = 1,414) = 0.5521, p = 0.457458 p > 0.05).

Discussion

The chi-squared test supports that there is no significant difference in the chances of collisions between the sex classifications of golden-mantled ground squirrels. However, while the differences are not statistically significant, because relatively few animals were killed compared

to the number not killed, they may be biologically significant. Adult males were killed at a slightly higher rate than adult females (5.3% vs 4.2%). This is what I expected because adult males move around more than females who are territorial of their burrows (Schwagmeyer Brown, 1983). However, the difference was not so large to be statistically significant. As stated before GMGS's mating season is during the spring (late April-May), which also correlates with the road being closed (usually until mid-May). This may be the reason behind lower than expected rates of males in vehicle collisions. Juvenile males were also killed at a slightly higher rate than juvenile females (4% vs. 2.7%).

Juvenile GMGS overall had lower rates of vehicle collisions than adults. A reason why this might have been the result is that juveniles are only present for the second half of the summer, so have less encounters with the road than adults have had. In other words, juvenile ground squirrels have less amount of experiences when being around or crossing over roads, while on the other hand, adult GMGS are continuously crossing roads when they need to find food, water, or when they are mating.

As for adult males, they may have been the highest roadkills out of all the ages and both sexes because they are moving around the most during the mating season, and for the rest of the summer to find their own food. Some areas might have better resources than others, therefore forcing them to search for food. Juvenile females have the lowest roadkills, perhaps because they do not disperse as often. Overall, adult GMGS had the highest rates of roadkill, this may be because adults over all have had more encounters with the roads than juveniles and this may be the reason why they have higher rates of vehicle collisions overall for males and females.

In the beginning of this research paper it was hypothesized that a higher proportion of male juveniles will have vehicle collisions than female juveniles. It was also expected that a higher proportion of adult males will have vehicle collisions than female adults, and finally it was expected that a higher proportion of juvenile squirrels will encounter vehicle collisions than adult squirrels. In conclusion, adult male GMGS more susceptible to motor vehicles than other ages and sex categories.

Literature Cited

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[Wells et al. 2017 Determinants of multiple paternity in a fluctuating population of ground squirrels.](#)

Tables and Figures

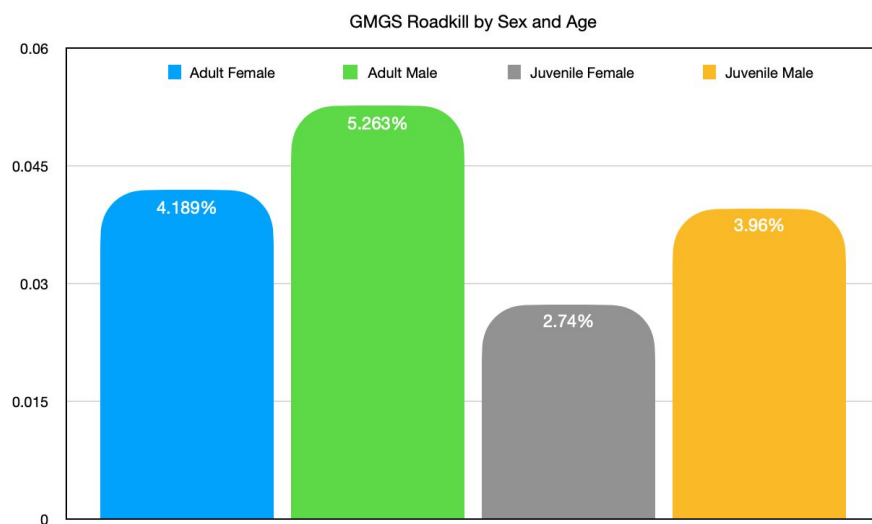


Figure No.1

Figure 1. Percentage of GMGS in vehicle collisions by categories of sex and age.

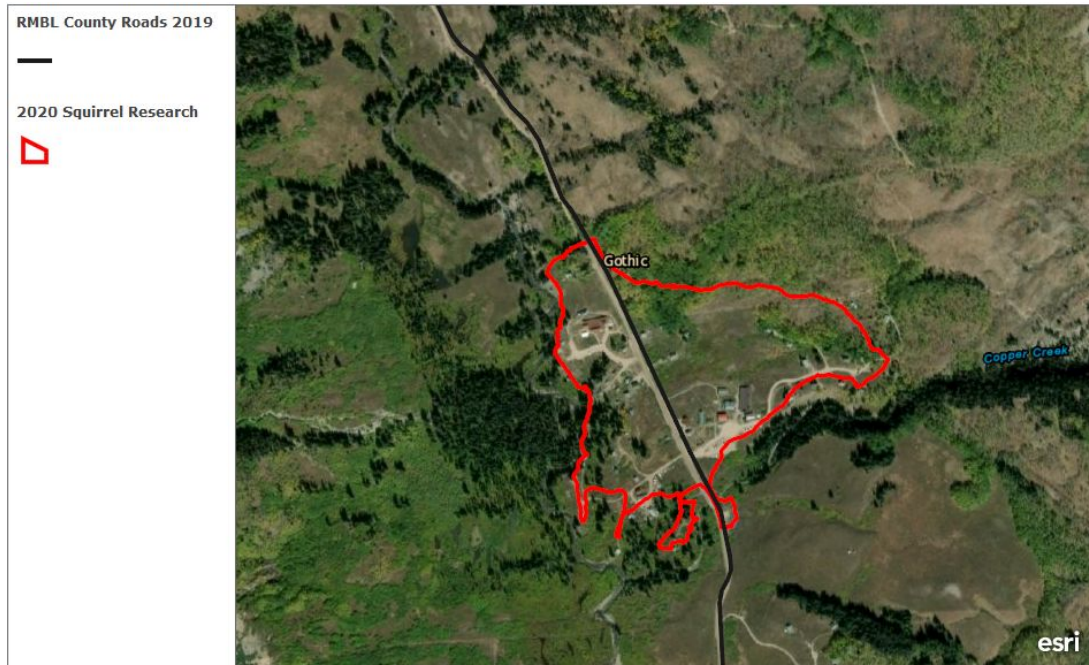


Figure 2. A map of RMBL townsite