Analysis of road kill data collected at Arthur River to test the efficacy of a virtual fence in reducing road kill

Prepared for:
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Executive Summary

A 12 km stretch of road on the east coast of Tasmania, near Arthur River, was chosen by Wildlife Safety Solutions (as advised by the Tasmanian Department of Primary Industries, Parks, Water and Environment) as an ideal test location for trialing the efficacy of a virtual fence on reducing road kill.

Monitoring along the 12 km stretch of road for road kill started on 11-Nov-2013. The virtual fence was installed, starting at the 6.4 km distance mark until the 10 km distance mark along the road, and became operational from 11-Feb-2014. After installation of the virtual fence, 49 road kill events occurred inside the virtual fenced area (i.e., a rate of 13.6 deaths per km), compared to 275 road kill events occurring outside the virtual fenced area (i.e., a rate of 32.7 deaths per km).

A paired t-test was conducted, testing whether the road kill rate inside the virtual fenced area was significantly different than inside the control area. The t-test results suggest the difference between the two areas is highly significant (t=-3.656, df=15, p-value=0.0023). The 95% confidence interval of the mean difference between the two areas is (-4.65, -1.22), and when interpreted along with the t-test results, this shows a significant decrease in road kill rate inside the virtual fence area compared to the control area. Based on these data, it is reasonable to believe that installing virtual fences as a management action to reduce road kill events is well-founded.

Recommendations

1) In this analysis, all road kill events were pooled across species so the efficacy of the fence at the species level was not investigated. Funding should be made available to conduct this analysis.
2) An interaction between time and efficacy of the fence was not investigated, as funding should be made available to conduct this analysis.
3) These results should be submitted for publication in a peer reviewed, scientific journal to increase credibility of the findings.
4) Other road kill ‘hot spots’ within Tasmania or mainland Australia should be investigated to further test the efficacy of the virtual fence on reducing road kill events.

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Data Integrity

Data were originally supplied by Wildlife Safety Solutions (Jack Swanepoel) via e-mail to The Analytical Edge on 25th November 2015 as an Excel spreadsheet ``Raw Data Nov'13-Sep'15.xlsx''. A number of discrepancies were discovered upon inspection of the data, and a corrected data set was supplied on 2nd December 2015.

Disclaimer: It is assumed these data provided by Wildlife Safety Solutions on 25-November-2015 and corrected on the 2-December-2015 are error-free. Detection of errors beyond those discussed here may require this analysis to be re-run under the proviso of new contract arrangements.

Exploratory Data Analysis

The length of road was monitored for road kill from 11/11/2013 up until the installation of the virtual fence (11th February, 2014), a total of 92 days.

During this time, 52 animal road kill events occurred (i.e., an average rate of 0.56 per day). The average number of deaths per day varied considerably by month (Table 1, from 0.85 in November 2013, to 0.3 in February 2014. Note, both of these months have a shorter number of days monitored, 20 and 10, respectively, and this might be a sampling anomaly rather than general trend).

Table 1. Road deaths along the 12 km stretch of road, prior to the installation of the virtual fence.

Month	Deaths	Days Monitored	Deaths / day
Nov	17	20	0.85
Dec	15	31	0.48
Jan	17	31	0.55
Feb	4	10	0.4

If there was no north-south density gradient along the road, we would expect the number of deaths along the road to be independent of distance along the road (i.e., a histogram of deaths would be a uniform distribution), and this seems to be the case for data collected prior to the installation of the virtual fence (Figure 1).

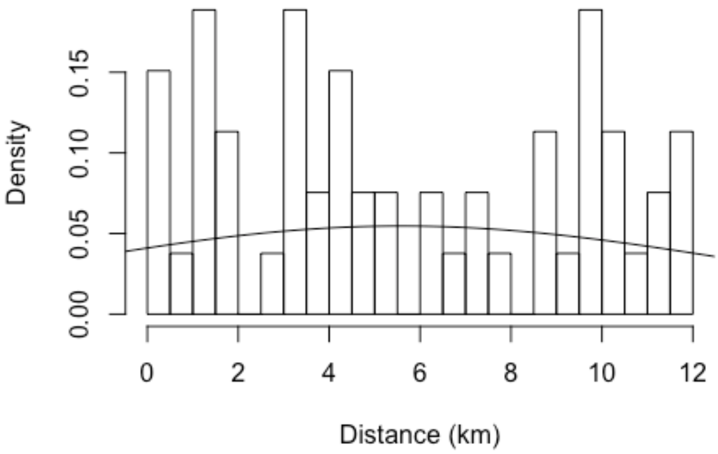

Figure 1. Histogram of the distances of detected road kill deaths along the road surveyed, prior to installation of the virtual fence. A smoothed line is fitted to the frequency data.

Final data set

The final data set had 376 road kill events, of which, 52 events occurred before the installation of the fence (i.e., along the entire road way). After the installation of the virtual fence, 49 events occurred inside the fenced area (i.e., a rate of 13.61 deaths per km), and 275 events occurred outside the virtual fenced area (i.e., a rate of 32.74 deaths per km, Figure 2).

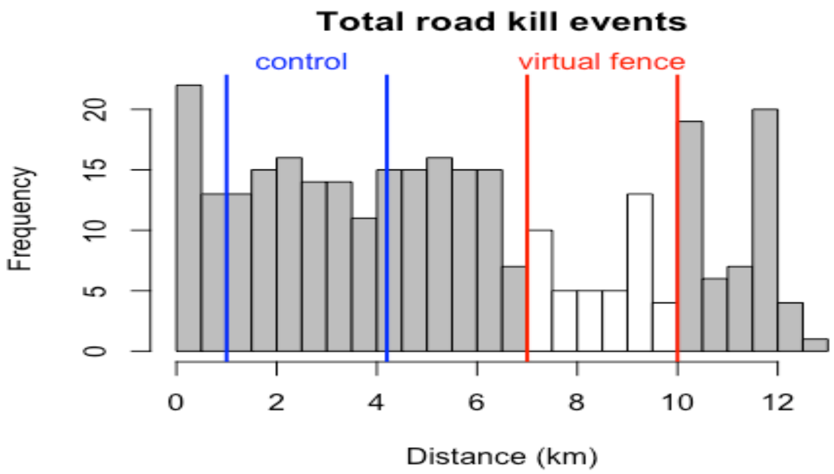

Figure 2. Histogram of the final data set containing 376 road kill events.

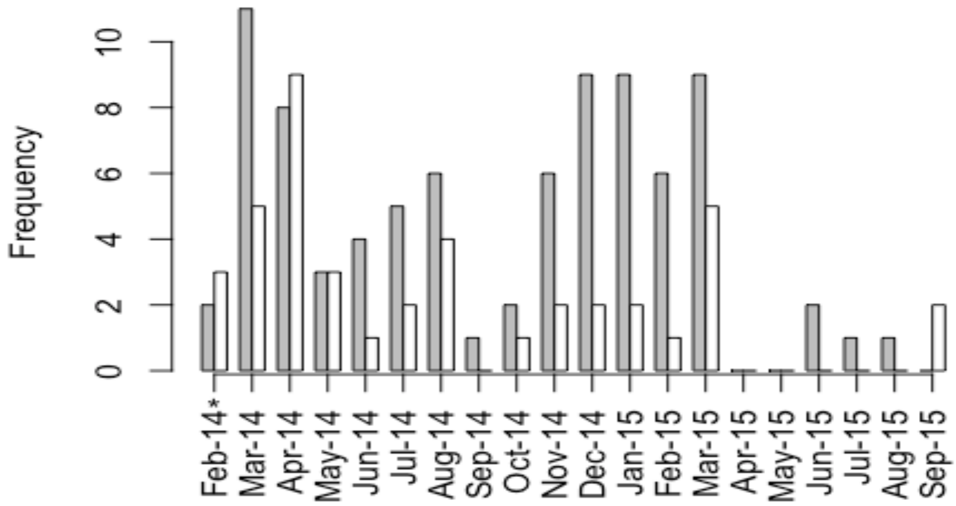

Figure 3. Paired barplot of the frequency of road kill rates in the control area (grey) and the virtual fenced area (white) after the installation of the virtual fence. NB., as the virtual fence was installed on the 11th February 2014, only half of this month was surveyed (highlighted by an asterisk).

Methods

The rates of road kill events at the control site before and after the installation of the fence were compared. Because the survey prior to fence installation was limited to four months (Nov-Feb), to reduce seasonal variation, for this analysis only data from months that were surveyed prior to installation were used. This analysis was conducted to ensure no change occurred (or, at least, was detected), within the control site before and after the installation of the fence, such that any difference found when comparing the control and treatment site could be likely attributed to a treatment effect.

The rates of road kill events after the fence installation between the control and treatment (virtual fenced) areas were compared, whilst accounting for any seasonal pattern in road kill.

It is assumed that:

1. Detectability of road kill is perfect within both areas, or at least, road kill events are missed at random, and not dependent on species, different observers, different survey conditions such as weather, etc.
2. Distribution of species available to be killed on the road is the same in both areas.
3. Use of the road by cars is constant across the region and equal in both areas (i.e., any car will drive through both the control and virtual fence area, and at a similar speed in both areas).
4. Efficacy of the virtual fence is constant for all species, or at least, there is no species-fence efficacy interaction. Once species-specific data has been digitized from the original data sheets, a species-specific analysis should be run.

A one-sided paired t-test between road kill rates between treatment types, for each month across the survey period. I assumed variances between the two groups were not equal. The null hypothesis was that there was no difference between the rates of road kill in each group. The alternative hypothesis was that the rate of road kill was not equal in the virtual fenced area, compared to the control area. I used the statistical software program, R v.3.2.2 (www.cran.r-project.org).

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Results

The effect that the virtual fence had on reducing road kill events in this study was considerable. The results from the t-test suggest the difference between the two areas is highly significant (t=-3.656, df=15, p-value=0.0023). The 95% confidence interval of the difference between the two areas is (-4.65, -1.22).

No statistically significant effect was detected within the control site before and after the installation of the virtual fence (t=-2.53, df=3, p-value=0.0854). The 95% confidence interval of the difference between the two time periods is (-9.03, 1.03).

Consequently, the difference detected between the control site and virtual fenced area is likely to be attributable to the virtual fence rather than some other factor. It is reasonable to assume that installing virtual fences as a management action to reduce road kill is very well-founded, and other road kill 'hot spots' within Tasmania or mainland Australia should be investigated to further test the efficacy of the virtual fence on reducing road kill events.

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