Appendix C. Reducing survey number and duration

Landscape scale effects

Number and length of transects

With the aim of creating the most time and cost-effective method while still producing robust results and detecting effects, we analysed subsets of the A487 transect data after our first year of survey using the GEE method to investigate the effect of reducing transect number, length and the number of spot checks (Table B1). Significant road effects were still detected when the number of transects was reduced to eight (four in each direction), but effects became non-significant below this number. The significance of road effects decreased quickly when transect length was shortened (see Table B1). For transects shorter than 1000 m in length, the significance of effects decreased to either become non-significant, or closer to the $P < 0.05$ cut-off point used to assign statistical significance. Removing the 50 m spot check had little effect on the significance of road effects. However, reducing spot checks from every 100 m to every 200 m caused significance levels to drop.

We suggest that the optimum combination to retain the level and significance of road effects detected using the GEE method is to have a minimum of 10 transects (5 in each direction, away and towards the road) of 1000 m with 11 spot checks (every 100 m from 0 to 1000 m). For the A487 data this combination produces significant, robust and relatively consistent results that are well within the significance thresholds when tested on three different subsets of the data (10 most northerly transects, 10 most southerly transects and 10 random transects, see Table B2 and Figure B1).

Table B1. Results from the GEE analysis for the full A487 dataset and subsets of the data. Predicted increase is between 0 and 1000 m from the road (n.s. = not significant)

Transect modification	Total bat passes	Estimate for distance (m)	SE	*P*	Predicted increase in bat activity (%)
Full dataset (n = 14, 1000 m length, 12 spot checks)	9,571	0.00146	0.00052	0.0074	89
Transect n = 12	8,728	0.00144	0.00057	0.012	92
Transect n = 10	7,715	0.00166	0.00059	0.0045	125
Transect n = 8	7,086	0.00141	0.00059	0.017	88
Transect n = 6	6,754	0.00121	0.00068	0.075 n.s.	58
Length = 900 m	8,464	0.00134	0.00059	0.023	79
Length = 800 m	7,808	0.00114	0.00074	0.12 n.s.	66
Length = 700 m	7,454	0.00209	0.00093	0.026	136
Length = 600 m	4,212	0.00104	0.00123	0.4 n.s.	61
Length = 500 m	3,327	0.00072	0.00131	0.58 n.s.	42
Spot checks n = 11 (excl. 50 m)	9,141	0.00152	0.00052	0.0037	94
Spot checks n = 6 (every 200 m)	3,507	0.00150	0.00061	0.013	102

Table B2. Results from the GEE analysis for different subsets of the A487 data. All subsets have 10 transects of 1000 m length and 11 spot checks. Predicted increase is between 0 and 1000 m from the road (n.s. = not significant)

Site	Subset tested	Total bat passes	Estimate for distance (m)	SE	*P*	Predicted increase in bat activity (%)
A487	10 south transects	7,458	0.00171	0.0006	0.0042	132
	10 north transects	3,289	0.00153	0.00051	0.0028	113
	10 random transects	7,615	0.00208	0.00063	0.0009	174

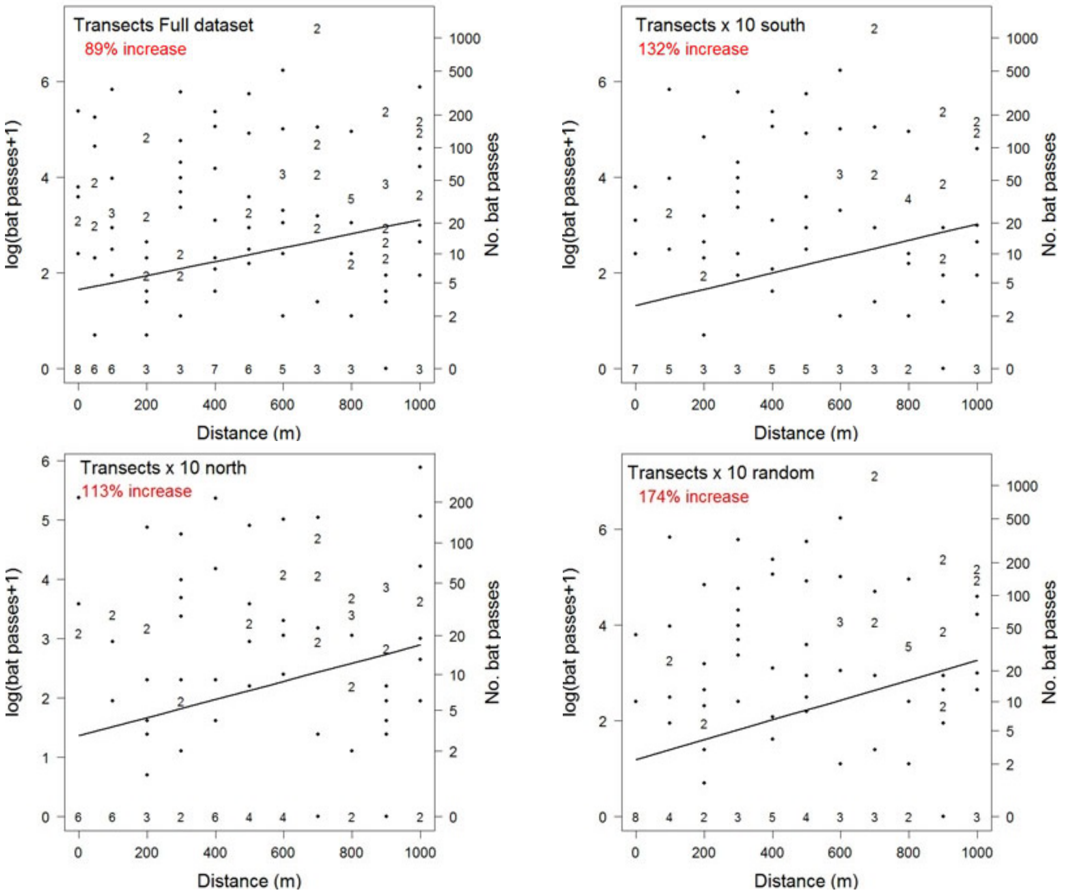

Figure B1. The effect of distance from the A487 on the number of bat passes as predicted by each GEE model for the full dataset and different subsets of the data. Plots show model predictions with full range of data points on a log scale (numbers represent replicate points, right y axes show the original scale for reference). Percentage increase is the predicted effect on bat passes between 0 and 1000 m from the road.

Local scale effects

We also evaluated the method used for assessing mitigation measures for time and cost-effectiveness. Upon inspection of the results it was clear that at certain times after sunset and before sunrise the number of visual observations of crossing bats dropped dramatically and the number of bats that were detected but not seen increased. This was most evident during the last half an hour of the dusk survey and first half an hour of the dawn survey due to poor light levels at these times (see Figure B2 for an example). We therefore suggest that the survey duration is reduced to one hour (one hour after sunset and one hour before sunrise), as beyond this time few useful records are made.

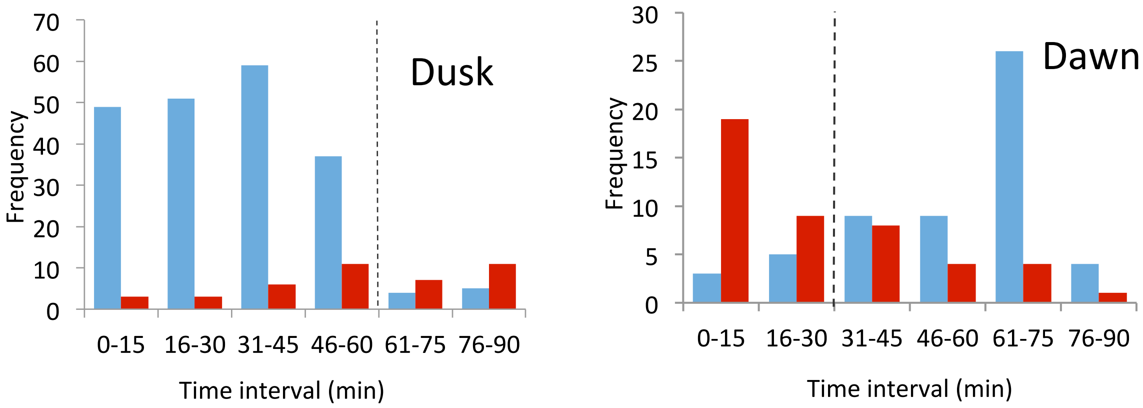

Figure B2. The number of records per 15 minute time intervals during dusk and dawn surveys at the environmental overbridge. Blue = positive observations, red = bat detected but not seen. Total number of surveys = 4 at dusk, 2 at dawn. Dashed line indicates suggested survey reduction (remove last 30 min from dusk survey and first 30 min from dawn survey).

We conducted between six and ten surveys per mitigation feature. We found that useful comparisons and statistical tests could still be made with just six surveys, and suggest this as a minimum to assess mitigation measures (with at least three of the surveys conducted at dusk when activity is generally higher). This should provide adequate data to evaluate the effectiveness of a mitigation feature using our analysis methods, and would also allow for pre-and post-construction comparisons should the data be available. In areas of low bat activity, six surveys may not produce sufficient data for analysis. However, methods to assess bat mitigation are not expected to be required in areas where bat activity is low, unless of course activity has dropped considerably since road construction, but comparisons of pre- and post- construction data would reveal this. Similarly, we were unable to carry out statistical analysis for the less abundant species at each site. Statistical significance is not a critical requirement, but there needs to be sufficient data to ensure that the observed patterns are representative of the behaviour of the bat population. If a species has declined dramatically in number since construction, then this again would be revealed by comparison of pre- and post-construction surveys.