Supplementary Material

Life in the big smoke: terrestrial vertebrate assemblages and their drivers along an urbanisation gradient in Sydney, Australia

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Linear regression model and species-habitat plots

Table S1. Summary of linear regression model analysis with Shannon–Weiner diversity index for native species as the response variable and invasive species richness as the explanatory variable.

Factor	Estimate	s.e.	*t*-value	*P*-value
(Intercept)	0.811	0.081	10.038	<0.001*
Invasive richness	-0.165	0.053	-3.116	0.005*

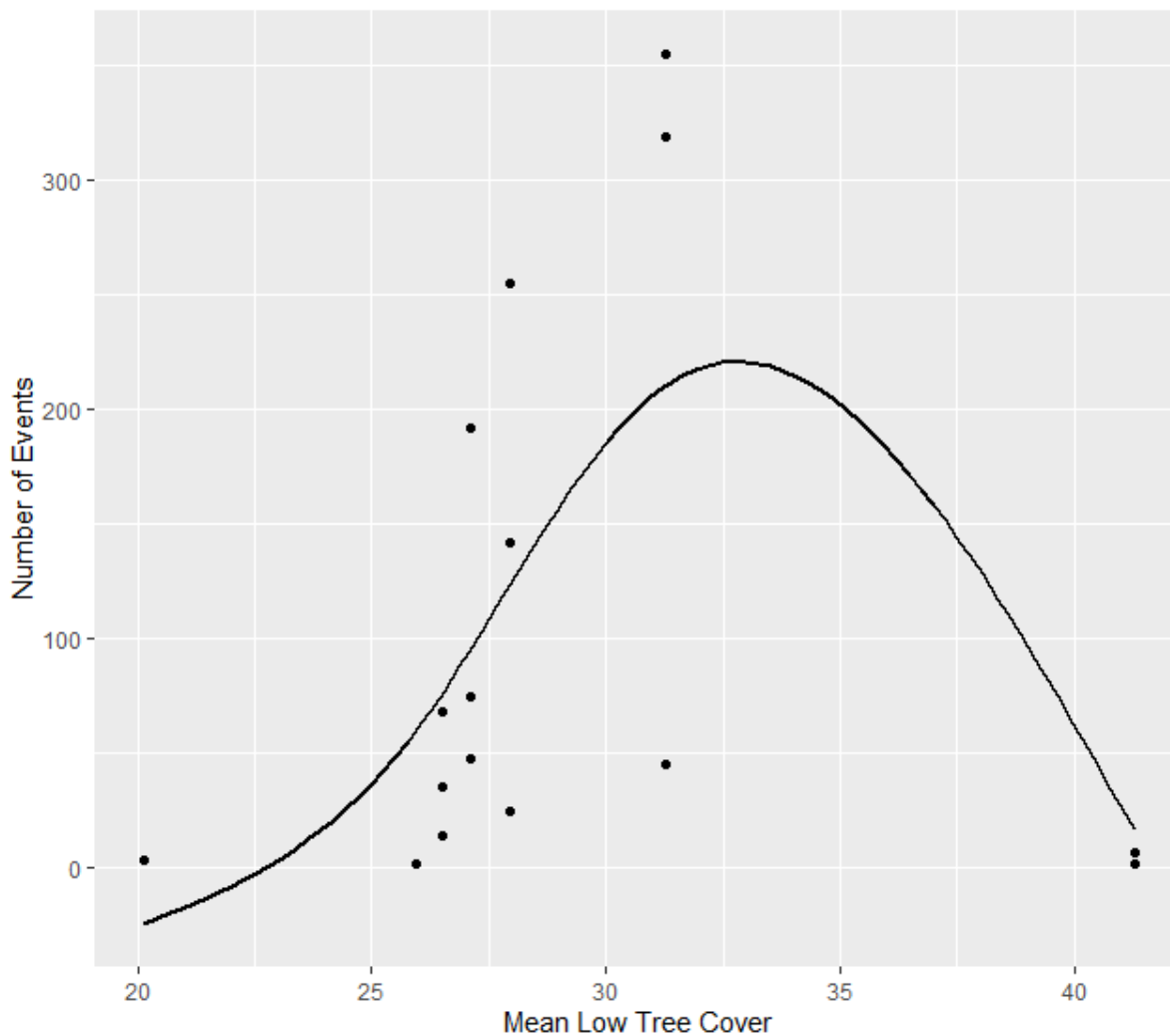Significant *P*-values marked with an asterisk (*).

Figure S1. Scatter plot of the relationship between the number of black rat events and mean low tree cover (%) across all urbanisation levels. Correlation = 0.004600721.
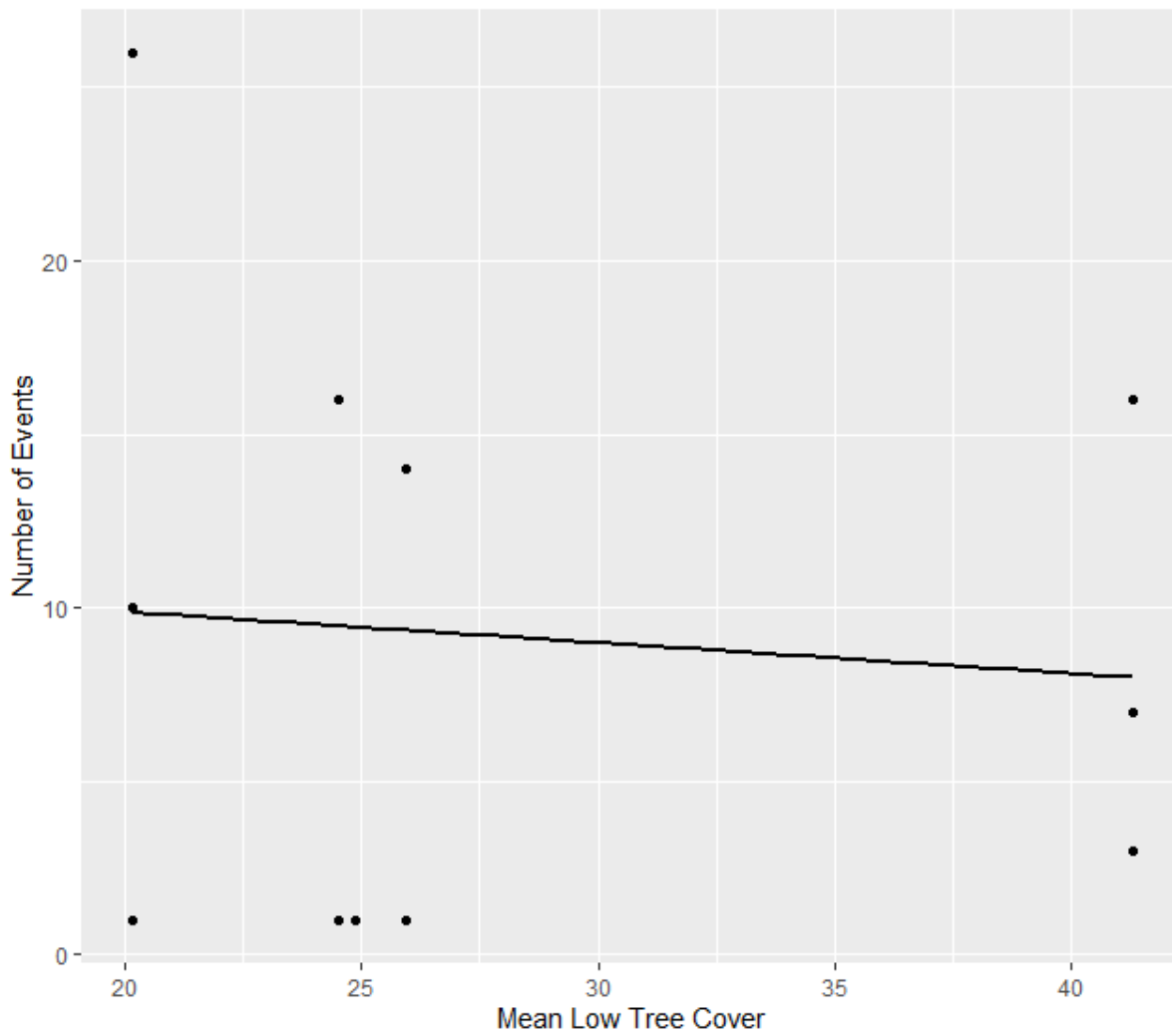
Figure S2. Scatter plot of the relationship between the number of brown antechinus events and mean low tree cover (%) across all urbanisation levels. Correlation = -0.09034655.

Figure S3. Scatter plot of the relationship between the number of brush turkey events and mean low tree cover (%) across all urbanisation levels. Correlation = -0.09836379.

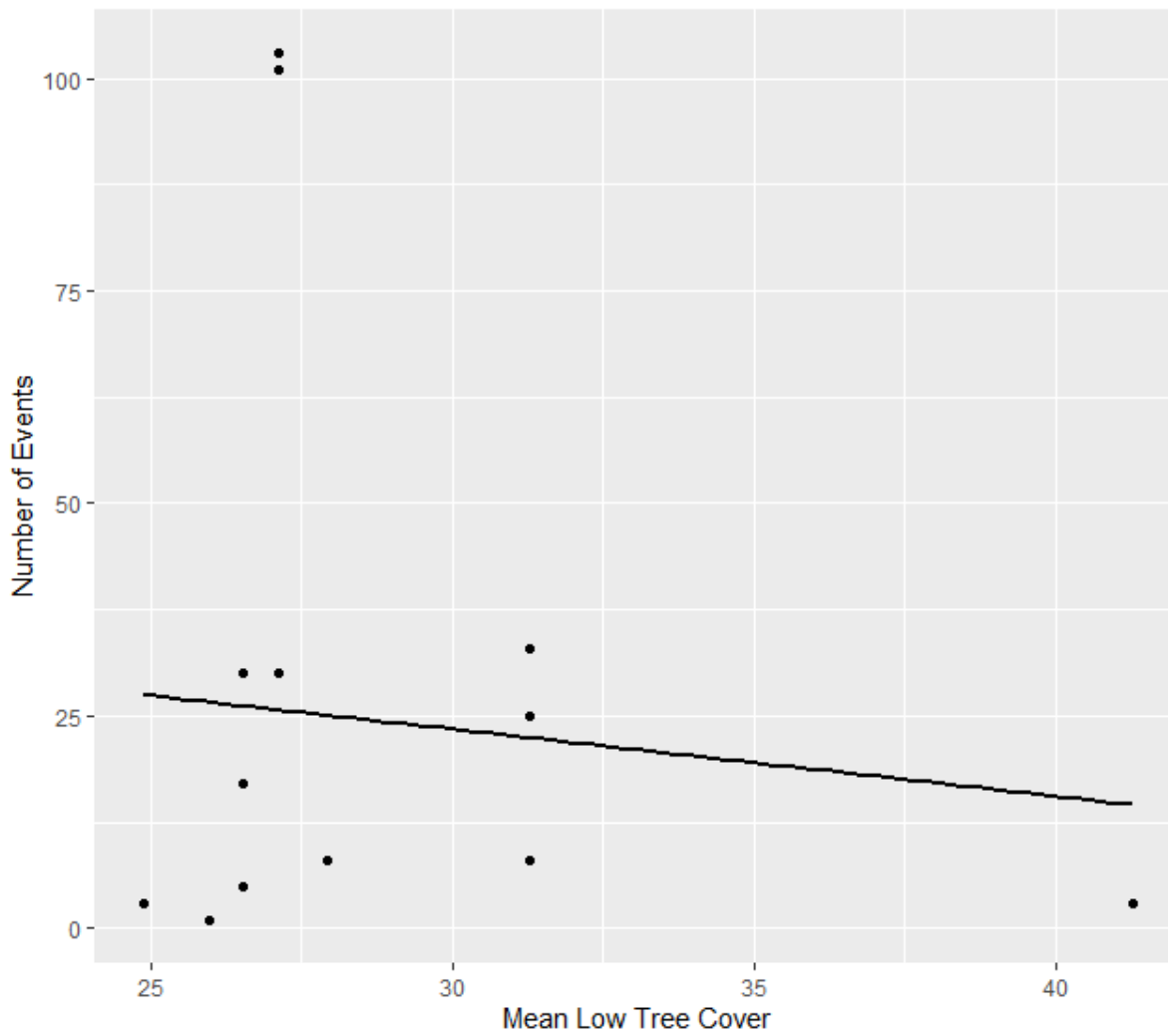**Figure S4.** Scatter plot of the relationship between the number of bush rat events and mean low tree cover (%) across all urbanisation levels. Correlation = -0.4899632.
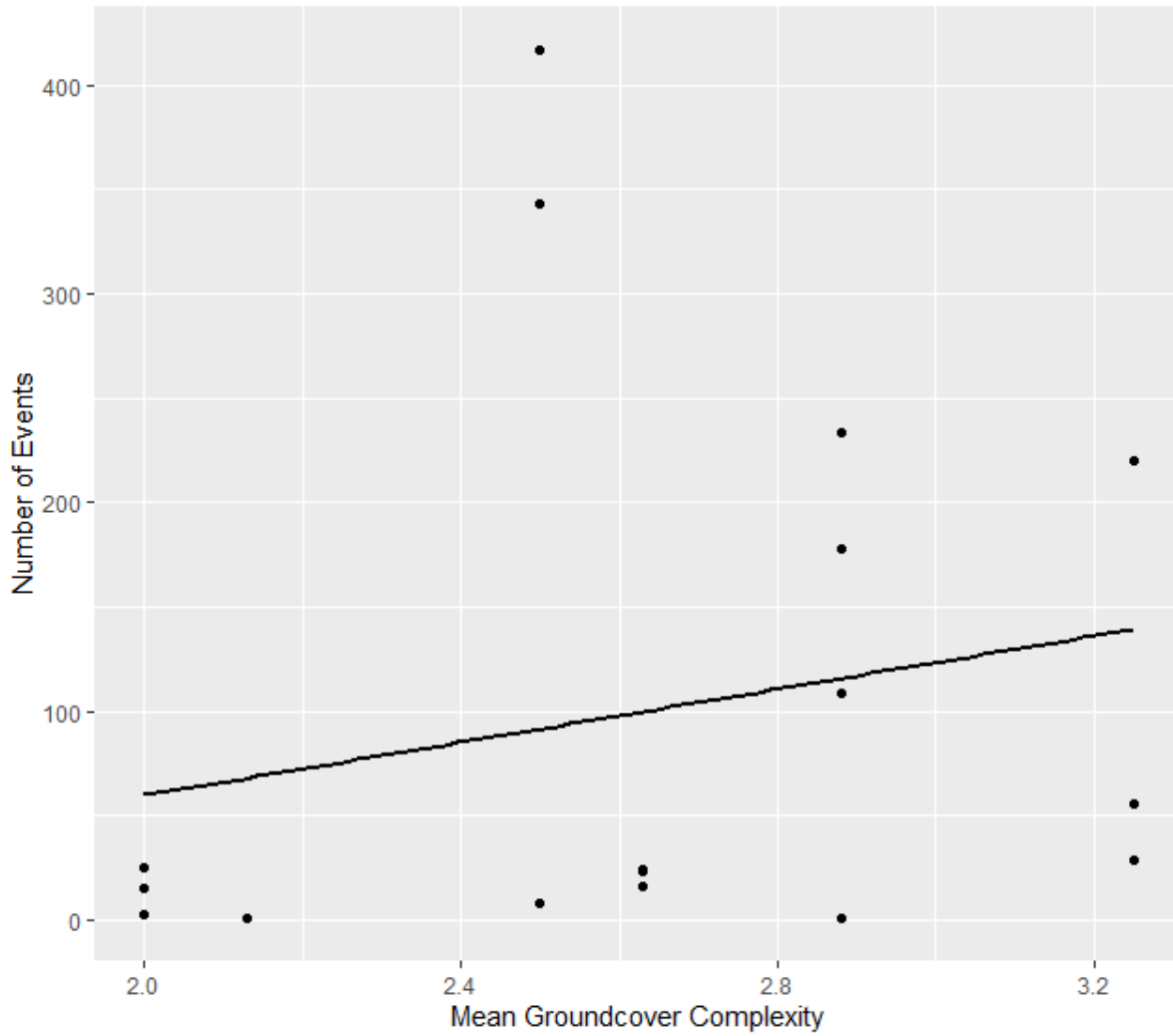
Figure S5. Scatter plot of the relationship between the number of bush rat events and mean groundcover complexity (%) across all urbanisation levels. Correlation = 0.2067564.
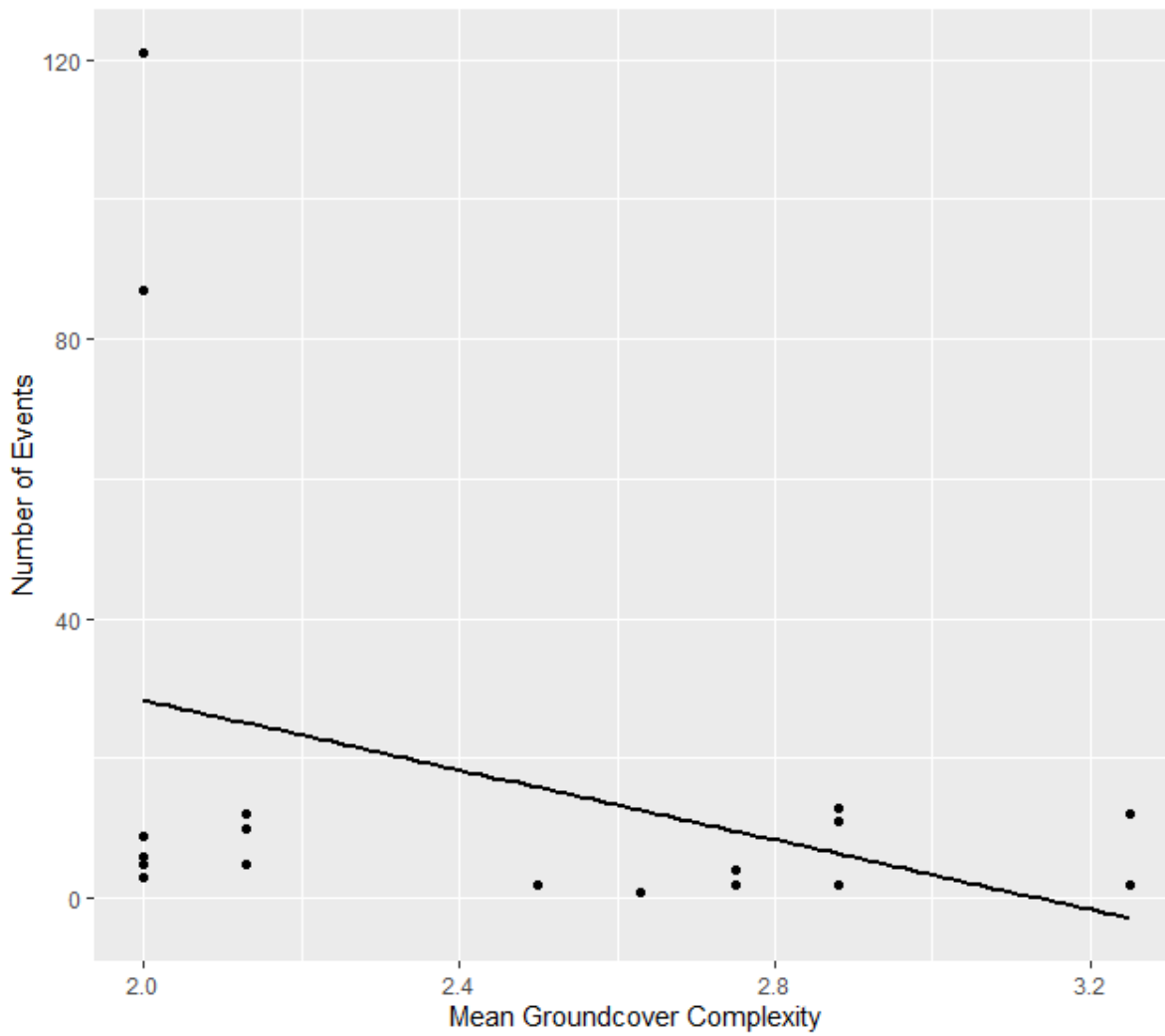
Figure S6. Scatter plot of the relationship between the number of long nose bandicoot events and mean groundcover complexity (%) across all urbanisation levels. Correlation = -0.3529831.

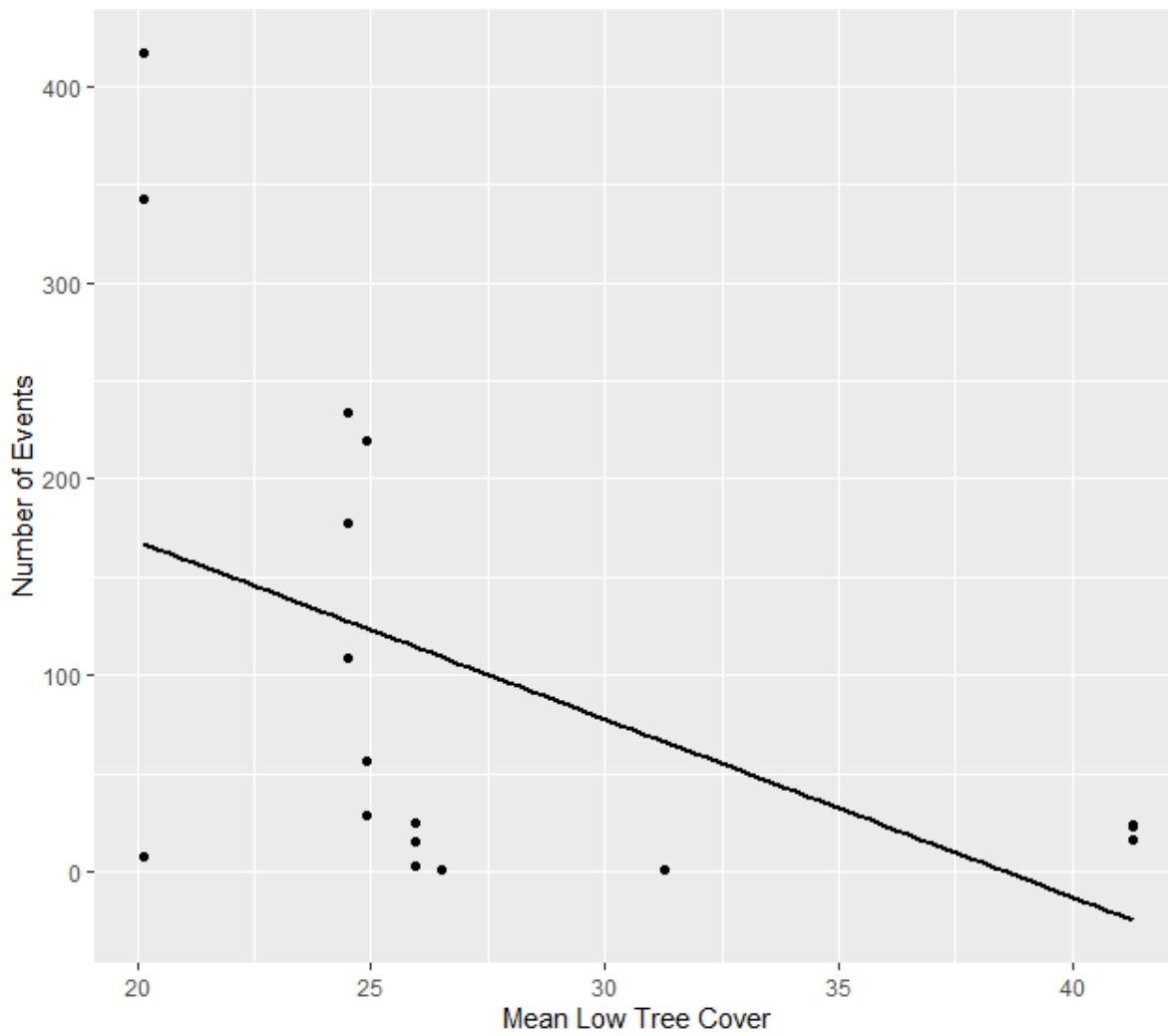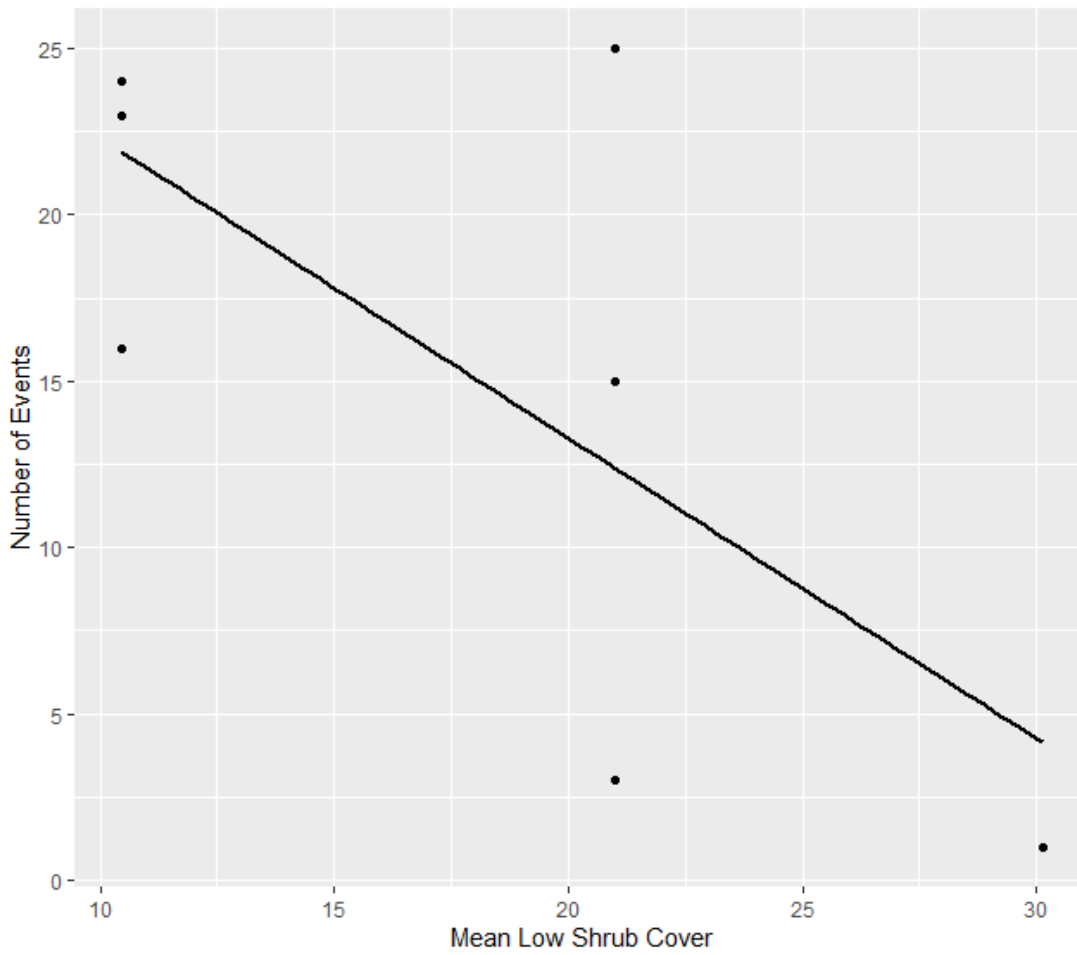**Figure S7.** Scatter plot of the relationship between the number of bush rat events and mean low shrub cover (%) in mid-urban sites. Correlation = -0.692634.
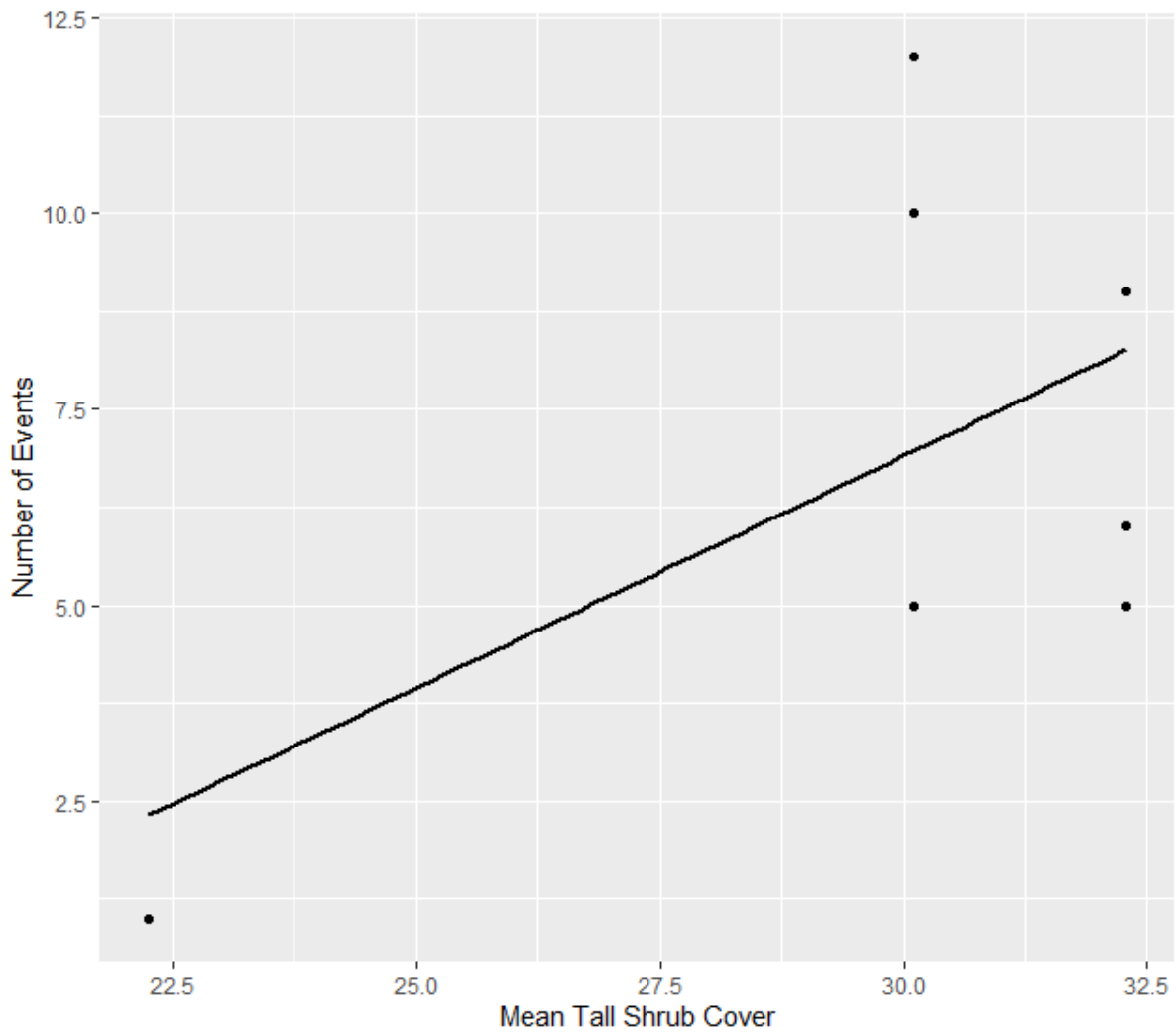
Figure S8. Scatter plot of the relationship between the number of long-nosed bandicoot events and mean tall shrub cover (%) in mid-urban sites. Correlation = 0.565672.
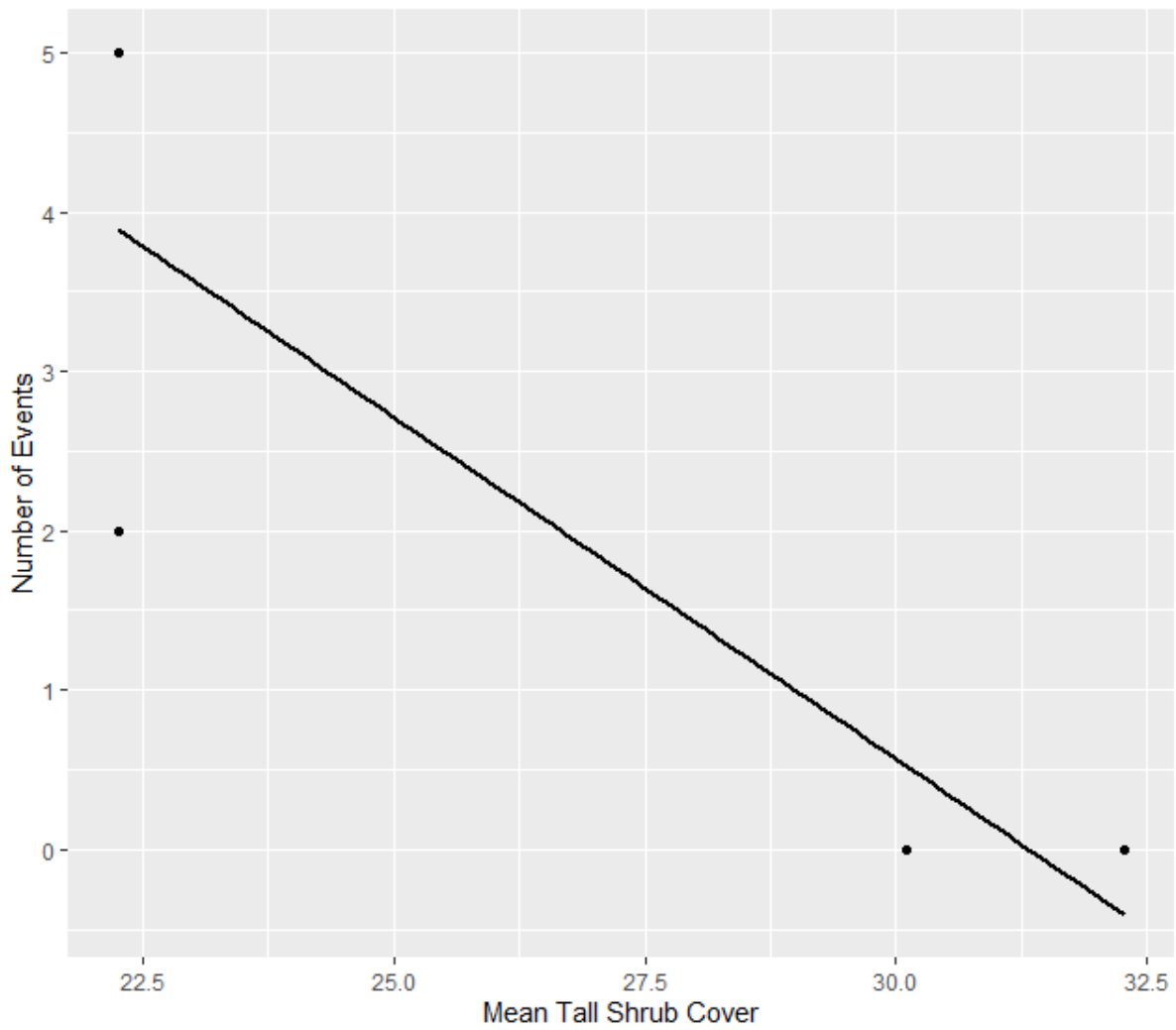
Figure S9. Scatter plot of the relationship between the number of superb lyrebird events and mean tall shrub cover (%) in mid-urban sites. Correlation = -0.8980149.

Meat bait camera set up

Figure S10. Plastic compartment used to hold chicken neck baits so that the bait could be smelt but not taken.

PERMANOVA result

Table S2. Results from pairwise PERMANOVA assessing species assemblages across urbanisation scales.

Pair	*F* model	R^2	*P*-value
Highly urban *v*. Low urban	61.583	0.794	0.003
Highly urban *v*. Mid urban	17.427	0.521	0.003
Low urban *v*. Mid urban	4.723	0.228	0.006

Mvabund analysis

Table S3. **Results from the 'manyglm' function assessing species activity (number of events) in response to the recorded vegetation characteristics within the assemblages recorded at all urbanisation levels.**

Multivariate test				
Factor	Residual d.f.	d.f. difference	Deviance	*P*-value
(Intercept)	26			
Tall shrub cover	25	1	16.69	0.387
Low shrub cover	24	1	23.75	0.208
Low tree cover	23	1	102.13	0.002*
Number of logs	22	1	54.70	0.035*
Groundcover complexity	21	1	58.52	0.002*
Pairwise test				
Species		**Variable**	**Deviance**	***P*-value**
Bird species		Low shrub cover	1.165	0.913
		Tall shrub cover	0.254	0.998
		Low tree cover	0.27	0.992
		Number of logs	0.073	0.901
		Groundcover complexity	6.224	0.291
Black rat		Low shrub cover	1.811	0.908
		Tall shrub cover	0.059	1.000
		Low tree cover	21.325	0.007*
		Number of logs	7.673	0.206
		Groundcover complexity	2.719	0.663
Brown antechinus		Low shrub cover	1.523	0.913
		Tall shrub cover	1.137	0.963
		Low tree cover	18.045	0.007*
		Number of logs	8.339	0.184
		Groundcover complexity	1.14	0.894
Brush turkey		Low shrub cover	2.39	0.822
		Tall shrub cover	1.38	0.940
		Low tree cover	12.863	0.036*
		Number of logs	0.43	0.901
		Groundcover complexity	0.255	0.962

Bush rat		Low shrub cover	1.053	0.913
		Tall shrub cover	0.102	1.000
		Low tree cover	11.109	0.045*
		Number of logs	7.663	0.206
		Groundcover complexity	25.076	0.001*
Common brushtail possum		Low shrub cover	1.737	0.913
		Tall shrub cover	1.048	0.964
		Low tree cover	0.105	0.992
		Number of logs	4.598	0.400
		Groundcover complexity	0.04	0.962
Domestic cat		Low shrub cover	0.005	0.958
		Tall shrub cover	0.05	1.000
		Low tree cover	4.381	0.429
		Number of logs	0.004	0.901
		Groundcover complexity	0	0.962
Domestic dog		Low shrub cover	0.022	0.958
		Tall shrub cover	0.012	1.000
		Low tree cover	4.65	0.419
		Number of logs	3.052	0.558
		Groundcover complexity	1.626	0.801
Eastern pygmy possum		Low shrub cover	0.696	0.913
		Tall shrub cover	6.451	0.183
		Low tree cover	0	0.992
		Number of logs	0	0.901
		Groundcover complexity	0	0.962
Long-nosed bandicoot		Low shrub cover	2.521	0.822
		Tall shrub cover	0.021	1.000
		Low tree cover	0.001	0.992
		Number of logs	2.418	0.662
		Groundcover complexity	17.193	0.009*

European rabbit		Low shrub cover	1.347	0.913
		Tall shrub cover	0.245	0.998
		Low tree cover	3.373	0.607
		Number of logs	0	0.901
		Groundcover complexity	0	0.962
Red fox		Low shrub cover	0.484	0.917
		Tall shrub cover	0.004	1.000
		Low tree cover	10.624	0.056
		Number of logs	0.738	0.891
		Groundcover complexity	0.55	0.962
Ringtail possum		Low shrub cover	3.25	0.704
		Tall shrub cover	0.001	1.000
		Low tree cover	6.36	0.260
		Number of logs	0.172	0.901
		Groundcover complexity	0.411	0.962
Short-beaked echidna		Low shrub cover	0.11	0.958
		Tall shrub cover	0.014	1.000
		Low tree cover	0.192	0.992
		Number of logs	4.179	0.423
		Groundcover complexity	3.184	0.656
Superb lyrebird		Low shrub cover	4.149	0.589
		Tall shrub cover	5.719	0.235
		Low tree cover	1.024	0.905
		Number of logs	7.05	0.206
		Groundcover complexity	0	0.962
Swamp wallaby		Low shrub cover	1.484	0.913
		Tall shrub cover	0.238	0.998
		Low tree cover	7.803	0.165
		Number of logs	8.313	0.184
		Groundcover complexity	0.105	0.962

Results are derived using the '*mvabund*' package. Significant *P*-values marked with an asterisk (*).

Table S4. Results from the 'manyglm' function assessing species activity (number of events) within the assemblages recorded across urbanisation scales.

Multivariate test				
Factor	Residual d.f.	d.f. difference	Deviance	*P*-value
(Intercept)	26			
Urban scale	24	2	183.7	0.001
Pairwise test				
Species		**Variable**	**Deviance**	**P-value**
Bird species		Urban scale	4.502	0.713
Black rat		Urban scale	25.163	0.001*
Brown antechinus		Urban scale	14.373	0.013*
Brush turkey		Urban scale	12.731	0.036*
Bush rat		Urban scale	37.307	0.001*
Common brushtail possum		Urban scale	8.355	0.231
Domestic cat		Urban scale	2.197	0.713
Domestic dog		Urban scale	6.592	0.395
Eastern pygmy possum		Urban scale	4.906	0.713
European rabbit		Urban scale	2.322	0.713
Long-nosed bandicoot		Urban scale	4.85	0.713
Red fox		Urban scale	4.08	0.713
Ringtail possum		Urban scale	18.39	0.002*
Short-beaked echidna		Urban scale	3.821	0.713
Superb lyrebird		Urban scale	4.831	0.713
Swamp wallaby		Urban scale	29.314	0.001*

Results are derived using the '*mvabund*' package. Significant *P*-values marked with an asterisk (*).

Table S5. Results from the 'manyglm' function assessing species activity (number of events) within the assemblages recorded at low-urban sites.

Multivariate test				
Factor	**Residual d.f.**	**d.f. difference**	**Deviance**	***P*-value**
(Intercept)	**8**			
Low shrub cover	7	1	16.05	0.229
Tall shrub cover	6	1	21.95	0.231
Low tree cover	5	1	0.00	0.753
Number of logs	2	1	0.00	0.293
Groundcover complexity	4	1	0.00	0.995

Results are derived using the '*mvabund*' package. Significant *P*-values marked with an asterisk (*).

Table S6. Results from the 'manyglm' function assessing species activity (number of events) within the assemblages recorded at mid-urban sites.

Multivariate test				
Factor	**Residual d.f.**	**d.f. difference**	**Deviance**	***P*-value**
(Intercept)	**8**			
Low shrub cover	7	1	67.69	0.007*
Tall shrub cover	6	1	40.61	0.031*
Low tree cover	5	1	0.00	1.000
Number of logs	4	1	0.00	1.000
Groundcover complexity	3	1	0.00	1.000
Groundcover overage	6	1	0.00	1.000
Pairwise test				
Species		**Variable**	**Deviance**	***P*-value**
Bird species		Low shrub cover	0.843	0.556
		Tall shrub cover	1.613	0.770
		Low tree cover	0	1.000
		Number of logs	0	0.798
		Groundcover complexity	0	0.982
Black rat		Low shrub cover	12.026	0.057
		Tall shrub cover	0.887	0.770
		Low tree cover	0	0.846
		Number of logs	0	0.925
		Groundcover complexity	0	1.000
Brown antechinus		Low shrub cover	12.051	0.057
		Tall shrub cover	0.074	0.770
		Low tree cover	0	1.000
		Number of logs	0	0.793
		Groundcover complexity	0	0.954
Brush turkey		Low shrub cover	9.789	0.069
		Tall shrub cover	1.203	0.770
		Low tree cover	0	1.000
		Number of logs	0	1.000
		Groundcover complexity	0	1.000

Bush rat		Low shrub cover	14.638	0.044*
		Tall shrub cover	0.734	0.770
		Low tree cover	0	0.825
		Number of logs	0	0.925
		Groundcover complexity	0	1.000
Common brushtail possum		Low shrub cover	6.649	0.100
		Tall shrub cover	2.474	0.704
		Low tree cover	0	0.825
		Number of logs	0	1.000
		Groundcover complexity	0	0.491
Long-nosed bandicoot		Low shrub cover	7.183	0.100
		Tall shrub cover	10.75	0.042*
		Low tree cover	0	0.846
		Number of logs	0	0.925
		Groundcover complexity	0	0.982
European rabbit		Low shrub cover	0.001	0.556
		Tall shrub cover	2.643	0.704
		Low tree cover	0	1.000
		Number of logs	0	0.563
		Groundcover complexity	0	1.000
Red fox		Low shrub cover	1.54	0.556
		Tall shrub cover	4.943	0.350
		Low tree cover	0	1.000
		Number of logs	0	0.925
		Groundcover complexity	0	1.000
Superb lyrebird		Low shrub cover	0	0.556
		Tall shrub cover	14.932	0.027
		Low tree cover	0	1.000
		Number of logs	0	1.000
		Groundcover complexity	0	1.000

Swamp wallaby		Low shrub cover	2.967	0.289
		Tall shrub cover	0.36	0.770
		Low tree cover	0	1.000
		Number of logs	0	0.444
		Groundcover complexity	0	1.000

Results are derived using the 'mvabund' package. Significant P-values marked with an asterisk (*).

Table S7. Results from the 'manyglm' function assessing species activity (number of events) within the assemblages recorded at highly urban sites.

Multivariate test				
Factor	Residual d.f.	d.f. difference	Deviance	*P*-value
(Intercept)	8			
Low shrub cover	7	1	35.12	0.050*
Tall shrub cover	6	1	32.75	0.053
Low tree cover	5	1	0.00	0.633
Groundcover complexity	4	1	0.00	0.328
Number of logs	6	1	0.00	0.530
Pairwise test				
Species		Variable	Deviance	*P*-value
Black rat		Low shrub cover	1.829	0.694
		Tall shrub cover	0.002	0.987
		Low tree cover	0	1.000
		Number of logs	0	0.981
		Groundcover complexity	0	0.979
Brush turkey		Low shrub cover	0.628	0.854
		Tall shrub cover	9.284	0.083
		Low tree cover	0	1.000
		Number of logs	0	1.000
		Groundcover complexity	0	0.999
Common brushtail possum		Low shrub cover	4.283	0.460
		Tall shrub cover	5.951	0.274
		Low tree cover	0	0.778
		Number of logs	0	1.000
		Groundcover complexity	0	0.587

Domestic cat		Low shrub cover	2.016	0.694
		Tall shrub cover	0.182	0.982
		Low tree cover	0	1.000
		Number of logs	0	0.898
		Groundcover complexity	0	0.950
Domestic dog		Low shrub cover	2.668	0.570
		Tall shrub cover	0.105	0.982
		Low tree cover	0	1.000
		Number of logs	0	1.000
		Groundcover complexity	0	0.694
Long-nosed bandicoot		Low shrub cover	6.962	0.024
		Tall shrub cover	6.028	0.274
		Low tree cover	0	0.991
		Number of logs	0	0.580
		Groundcover complexity	0	0.930
Red fox		Low shrub cover	0.022	0.905
		Tall shrub cover	2.778	0.435
		Low tree cover	0	1.000
		Number of logs	0	0.976
		Groundcover complexity	0	0.999
Ringtail possum		Low shrub cover	4.183	0.460
		Tall shrub cover	0.022	0.987
		Low tree cover	0	0.875
		Number of logs	0	1.000
		Groundcover complexity	0	0.950

Short-beaked echidna		Low shrub cover	5.547	0.344
		Tall shrub cover	0.505	0.923
		Low tree cover	0	1.000
		Number of logs	0	0.950
		Groundcover complexity	0	0.950
Swamp wallaby		Low shrub cover	4.327	0.460
		Tall shrub cover	3.853	0.434
		Low tree cover	0	1.000
		Number of logs	0	1.000
		Groundcover complexity	0	0.733

Results are derived using the '*mvabund*' package. Significant *P*-values marked with an asterisk (*).

Table S8.   Mean values (±s.e.) for each habitat and spatial characteristic measured for each urbanisation level.

Mean value of each habitat characteristic measured for each urbanisation level			
Habitat Characteristic	**Low-urban**	**Mid-urban**	**High-urban**
Size of sampled patch (m²)	10,624.3 (±2,805.4)	13,350.7 (±2,883.9)	23,640.3 (±1,179.7)
Euclidean distance from the geometric patch centroid to the nearest paved road (m)	1,268.7 (±221.9)	132.7 (±24.4)	47.3(±6.8)
Last recorded fire (years)	27 (±6.9)	23(±1.5)	NA (Not burnt)
Euclidean distance from the patch boundary to the nearest other patch of native vegetation (m)	0	0	841.7 (±108.3)
Edge contrast	0	2.3 (±0.2)	3
Low shrub cover (%)	28.5 (±0.5)	20.5 (±2.8)	27 (±0.6)
Tall shrub cover (%)	32 (±4.1)	28.2 (±1.5)	29.9 (±0.6)
Low tree cover (%)	23.2 (±0.8)	31.3 (2.5)	28.8 (±0.6)
Number of logs	0.7 (±0.3)	3.7 (±0.8)	6 (±1.3)
Groundcover complexity	2.9 (±0.1)	2.3 (±0.1)	2.5 (±0.1)
Total area of forest cover in patch matrix (ha)	**Categorical - means are not deducible**		
Percentage of native vegetation surrounding patch (%)	**Categorical - means are not deducible**		
Euclidean distance from the patch boundary to the Sydney CBD	**Categorical - means are not deducible**		

Mean number of events per species, per site at each urbanisation level

Table S9.   Mean and range of the number of events (±s.e.) for each species at each site within each urbanisation level

Species	Mean + SE			Range (events)
	Low-urban	Mid-urban	High-urban	
Bird species	6.4 (± 4)	0.4 (± 0.3)	8.6 (± 5.7)	0 - 47
Black rat	0	13.9 (± 7.8)	161.4 (± 41.8)	0 - 355
Brown antechinus	5 (± 3.1)	6.1 (± 2.3)	0	0 - 26
Brush turkey	0.7 (± 0.4)	6.3 (± 3.5)	34.2 (± 13.4)	0 - 103
Bush rat	177.1 (± 47.1)	11.9 (± 3.6)	0	0 - 417
Common brushtail possum	0.1 (± 0.1)	12 (± 8.5)	6.1 (± 3.3)	0 - 74
Domestic cat	0	0	0.1 (± 0.1)	0 - 1
Domestic dog	0	0	0.3 (± 0.2)	0 - 1
Eastern pygmy possum	0.7 (± 0.5)	0	0	0 - 4
European rabbit	0	0.6 (± 0.6)	0	0 - 5
Long-nosed bandicoot	4.7 (± 1.9)	5.3 (± 1.5)	24.1 (± 15.4)	0 - 121
Red fox	0.7 (± 0.4)	1.3 (± 0.9)	3.3 (± 1.2)	0 - 11
Ringtail possum	0	0	4.2 (± 1.9)	0 - 17
Short-beaked echidna	0.2 (± 0.1)	0	0.3 (± 0.2)	0 - 2
Superb lyrebird	1 (± 0.9)	1.3 (± 0.7)	0	0 - 8
Swamp wallaby	47 (± 10.2)	46 (± 12.6)	1.7 (± 0.7)	0 -115