Table 12.—Bat echolocation activity was recorded each night and averaged each week. Insects were collected during the entire week of bat surveys. Results are displayed within each year as median followed by range in parentheses.

Variable	2015 (n=55)	2016 (n=63)	2017 (n=64)
Bat species richness	1 (0 - 3)	1 (0 - 2.14)	0.94 (0 - 2)
Big brown bat activity	19.83 (0 - 1,900)	12.57 (0 - 1,367.2)	4.65 (0 - 707.5)
Little brown bat activity	0 (0 - 3.86)	0 (0 - 0.71)	0 (0 - 0.29)
Northern long-eared bat activity	0 (0 - 0.17)	0 (0 - 0)	0 (0 - 1.07)
Tri-colored bat activity	0.42 (0 - 9.14)	0.09 (0 - 312.4)	0.08 (0 - 13.57)
Total bat activity	20 (0 - 1,900.75)	14.14 (0 - 1,372.6)	5.17 (0 - 718.33)
Blattodea	0 (0 – 0)	0 (0 - 1)	0 (0 - 7)
Coleoptera	6 (0 - 94)	3 (0 - 51)	2 (0 - 23)
Diptera	9 (0 - 178)	9 (0 - 89)	5 (0 - 77)
Ephemeroptera	0 (0 - 0)	0 (0 - 1)	0 (0 - 1)
Hemiptera	7 (0 - 185)	10 (0 - 699)	7 (0 - 114)
Hymenoptera	5 (0 - 372)	6 (0 - 53)	4 (0 - 80)
Lepidoptera	0 (0 - 1)	0 (0 - 4)	0 (0 - 1)
Orthoptera	0 (0 - 2)	0 (0 - 1)	0 (0 - 6)
Trichoptera	0 (0 - 13)	0 (0 - 2)	0 (0 - 8)
Total insects	45 (2 - 379)	45 (6 - 725)	27.5 (1 - 166)
Insect order richness	4 (1 - 6)	4 (2 - 6)	4 (1 - 7)
Insect Shannon H diversity	1.13 (0.08 – 1.35)	1.06 (0.17 – 1.37)	1.0 (0.0 – 1.57)

Table 13. Species-specific echolocation activity, total bat activity, and species richness were collected each night at each site then averaged each week to match timing of insects which were collected each week. All seasons and all years were combined. Results are displayed within each urbanization level (Urban, Suburban, and Rural) as median with range inside parenthesis.

Variable	Urban (n=59)	Suburban (n=62)	Rural (n=61)
Bat species richness	1 (0 - 2.43)	0.82 (0 - 2.14)	1.2 (0 - 3)
Big brown bat activity	13.67 (0 - 1,900)	3.48 (0 - 343.57)	21.57 (0 - 503.43)
Little brown bat activity	0 (0 - 2)	0 (0 - 0.71)	0 (0 - 3.86)
Northern long-eared bat activity	0 (0 - 0)	0 (0 - 1.07)	0 (0 - 0)
Tri-colored bat activity	0.40 (0 - 312.4)	0 (0 - 6.79)	0.6 (0 - 28.57)
Total bat activity	14.5 (0 - 1,900.75)	4 (0 - 343.57)	23.86 (0 - 505.57)
Blattodea	0 (0 - 7)	0 (0 - 0)	0 (0 - 1)
Coleoptera	2 (0 - 24)	2.5 (0 - 94)	6 (0 - 51)
Diptera	6 (0 - 89)	6 (0 - 85)	10 (0 - 178)
Ephemeroptera	0 (0 - 1)	0 (0 - 0)	0 (0 - 1)
Hemiptera	10 (0 - 110)	8 (0 - 699)	7 (0 - 114)
Hymenoptera	5 (0 - 372)	5 (0 - 55)	6 (1 - 259)
Lepidoptera	0 (0 - 4)	0 (0 - 1)	0 (0 - 1)
Orthoptera	0 (0 - 6)	0 (0 - 1)	0 (0 - 1)
Trichoptera	0 (0 - 3)	0 (0 - 2)	0 (0 - 13)
Total insects	33 (1 - 379)	32 (3 - 725)	38 (7 - 308)
Insect order richness	4 (1 - 6)	4 (1 – 5)	4 (1 - 7)
Insect Shannon H diversity	0.99 (0 – 1.35)	1 (0.16 – 1.37)	1.1 (0.12 – 1.57)

Table 14.—Median and ranges for bat echolocation activity, insect order counts and diversity were calculated within each season (spring, early summer, late summer, and autumn).

Variable	Spring	Early summer	Late summer	Autumn
Big brown bat activity	3.3 (0 - 119)	18 (0 - 503.43)	60.73 (0 - 1,900)	4 (0 - 1,376.9)
Tri-colored bat activity	0 (0 - 1.17)	0.08 (0 - 8.14)	1.34 (0 - 28.57)	0.5 (0 - 312.4)
Blattodea	0 (0 - 0)	0 (0 - 7)	0 (0 - 0)	0 (0 - 0)
Coleoptera	2 (0 - 22)	5 (0 - 94)	4 (0 - 37)	2 (0 - 34)
Diptera	6 (0 - 77)	10 (0 - 178)	9 (0 - 85)	4 (0 - 64)
Ephemeroptera	0 (0 - 0)	0 (0 - 1)	0 (0 - 1)	0 (0 - 0)
Hemiptera	2 (0 - 21)	8 (0 - 157)	9.5 (1 - 699)	11 (0 - 114)
Hymenoptera	5 (0 - 372)	6 (0 - 80)	5 (0 - 259)	5 (0 - 56)
Lepidoptera	0 (0 - 1)	0 (0 - 4)	0 (0 - 1)	0 (0 - 1)
Orthoptera	0 (0 - 0)	0 (0 - 6)	0 (0 - 1)	0 (0 - 2)
Trichoptera	0 (0 - 8)	0 (0 - 13)	0 (0 - 5)	0 (0 - 2)
Total insects	22 (1 - 379)	53 (3 - 233)	47 (4 - 725)	33 (6 - 169)
Insect Shannon H diversity	0.99 (0 – 1.37)	1.11 (0.27 – 1.35)	1.10 (0.16 – 1.57)	1.07 (0.43 – 1.37)

Table 16.—Correlation results between big brown bat activity (EPFU) and tri-colored bat activity (PESU) for all insect counts, total insects, and insect Shannon H diversity. Results are presented within each discrete urbaniztation level (Urban, Suburabn, and Rural). Correlations were not adjusted and all comparisons are reported along with degrees of freedom (unless noted by NA indicating not applicable). Insect codes include: Blattodea (BLAT), Coleoptera (COLE), Diptera (DIPT), Hemiptera (HEMI), Hymenoptera (HYME), Lepidoptera (LEPI), Orthoptera (ORTH), Trichoptera (TRIC), total insects (TOTA), and insect Shannon H diversity (SHAN). Results presented below include Spearman rho, degrees of freedom, followed by *P* value inside parentheses. Significant differences ($P < 0.05$) are indicated by asterisk * and bolded.

Level	Spring	Early summer	Late summer	Autumn
Urban	EPFU & BLAT (NA, NA, NA)	EPFU & BLAT (-0.463, 11, 0.111)	EPFU & BLAT (NA, NA, NA)	EPFU & BLAT (NA, NA, NA)
	EPFU & COLE (0.305, 14, 0.250)	**EPFU & COLE (0.632, 11, 0.020)***	EPFU & COLE (0.219, 15, 0.398)	**EPFU & COLE (0.628, 11, 0.022)***
	EPFU & DIPT (-0.251, 14, 0.348)	EPFU & DIPT (-0.206, 11, 0.499)	EPFU & DIPT (0.229, 15, 0.378)	**EPFU & DIPT (0.608, 11, 0.028)***
	EPFU & EPHE (NA, NA, NA)	EPFU & EPHE (0.231, 11, 0.447)	EPFU & EPHE (NA, NA, NA)	EPFU & EPHE (NA, NA, NA)
	EPFU & HEMI (0.411, 14, 0.114)	**EPFU & HEMI (0.754, 11, 0.003)***	**EPFU & HEMI (-0.536, 15, 0.027)***	EPFU & HEMI (-0.259, 11, 0.394)
	EPFU & HYME (-0.133, 14, 0.622)	EPFU & HYME (-0.233, 11, 0.444)	EPFU & HYME (0.031, 15, 0.906)	EPFU & HYME (0.249, 11, 0.412)
	EPFU & LEPI (-0.196, 14, 0.467)	EPFU & LEPI (0.096, 11, 0.755)	EPFU & LEPI (NA, NA, NA)	EPFU & LEPI (NA, NA, NA)
	EPFU & ORTH (NA, NA, NA)	EPFU & ORTH (-0.463, 11, 0.111)	EPFU & ORTH (NA, NA, NA)	EPFU & ORTH (-0.306, 11, 0.310)
	EPFU & TRIC (NA, NA, NA)	EPFU & TRIC (0.463, 11, 0.111)	EPFU & TRIC (0.408, 15, 0.104)	EPFU & TRIC (NA, NA, NA)
	EPFU & SHAN (0.300, 14, 0.259)	EPFU & SHAN (-0.346, 11, 0.247)	EPFU & SHAN (0.180, 15, 0.489)	EPFU & SHAN (0.517, 11, 0.071)
	PESU & BLAT (NA, NA, NA)	PESU & BLAT (-0.353, 11, 0.237)	PESU & BLAT (NA, NA, NA)	PESU & BLAT (NA, NA, NA)

	PESU & COLE (0.035, 14, 0.898)	PESU & COLE (0.153, 11, 0.618)	PESU & COLE (-0.268, 15, 0.298)	PESU & COLE (-0.111, 11, 0.717)
	PESU & DIPT (-0.319, 14, 0.229)	PESU & DIPT (0.306, 11, 0.309)	PESU & DIPT (-0.088, 15, 0.738)	PESU & DIPT (0.368, 11, 0.216)
	PESU & EPHE (NA, NA, NA)	PESU & EPHE (-0.353, 11, 0.237)	PESU & EPHE (NA, NA, NA)	PESU & EPHE (NA, NA, NA)
	PESU & HEMI (-0.288, 14, 0.279)	PESU & HEMI (-0.095, 11, 0.758)	PESU & HEMI (-0.103, 15, 0.695)	PESU & HEMI (-0.136, 11, 0.659)
	PESU & HYME (-0.570, 14, 0.704)	PESU & HYME (0.384, 11, 0.195)	PESU & HYME (0.128, 15, 0.625)	PESU & HYME (0.203, 11, 0.506)
	PESU & LEPI (-0.123, 14, 0.649)	PESU & LEPI (-0.084, 11, 0.784)	PESU & LEPI (NA, NA, NA)	PESU & LEPI (NA, NA, NA)
	PESU & ORTH (NA, NA, NA)	PESU & ORTH (-0.353, 11, 0.237)	PESU & ORTH (NA, NA, NA)	PESU & ORTH (-0.097, 11, 0.754)
	PESU & TRIC (NA, NA, NA)	PESU & TRIC (-0.353, 11, 0.237)	PESU & TRIC (-0.281, 15, 0.275)	PESU & TRIC (NA, NA, NA)
	PESU & SHAN (-0.220, 14, 0.413)	PESU & SHAN (0.061, 11, 0.842)	PESU & SHAN (0.066, 15, 0.802)	PESU & SHAN (0.199, 11, 0.515)
Suburban	EPFU & BLAT (NA, NA, NA)	EPFU & BLAT (NA, NA, NA)	EPFU & BLAT (NA, NA, NA)	EPFU & BLAT (NA, NA, NA)
	EPFU & COLE (0.053, 12, 0.857)	EPFU & COLE (0.245, 15, 0.344)	EPFU & COLE (0.075, 15, 0.775)	EPFU & COLE (0.162, 12, 0.581)
	EPFU & DIPT (-0.191, 12, 0.514)	EPFU & DIPT (0.133, 15, 0.611)	EPFU & DIPT (-0.178, 15, 0.495)	EPFU & DIPT (-0.236, 12, 0.416)
	EPFU & EPHE (NA, NA, NA)	EPFU & EPHE (NA, NA, NA)	EPFU & EPHE (NA, NA, NA)	EPFU & EPHE (NA, NA, NA)
	EPFU & HEMI (0.344, 12, 0.229)	EPFU & HEMI (0.069, 15, 0.792)	EPFU & HEMI (-0.020, 15, 0.940)	EPFU & HEMI (-0.396, 12, 0.162)
	EPFU & HYME (0.022, 12, 0.940)	EPFU & HYME (0.119, 15, 0.650)	EPFU & HYME (0.045, 15, 0.864)	EPFU & HYME (0.000, 12, 1.000)
	EPFU & LEPI (NA, NA, NA)	EPFU & LEPI (NA, NA, NA)	EPFU & LEPI (0.037, 15, 0.887)	EPFU & LEPI (-0.369, 12, 0.195)

	EPFU & ORTH (NA, NA, NA)	EPFU & ORTH (0.051, 15, 0.845)	EPFU & ORTH (0.085, 15, 0.746)	EPFU & ORTH (-0.153, 12, 0.603)
	EPFU & TRIC (0.380, 12, 0.180)	EPFU & TRIC (NA, NA, NA)	EPFU & TRIC (-0.408, 15, 0.104)	EPFU & TRIC (0.380, 12, 0.180)
	EPFU & SHAN (0.355, 12, 0.212)	**EPFU & SHAN (0.485, 15, 0.049)***	EPFU & SHAN (0.258, 15, 0.318)	EPFU & SHAN (0.135, 12, 0.645)
	PESU & BLAT (NA, NA, NA)	PESU & BLAT (NA, NA, NA)	PESU & BLAT (NA, NA, NA)	PESU & BLAT (NA, NA, NA)
	PESU & COLE (-0.287, 12, 0.320)	PESU & COLE (0.063, 15, 0.810)	PESU & COLE (-0.165, 15, 0.528)	PESU & COLE (0.342, 12, 0.231)
	PESU & DIPT (-0.069, 12, 0.815)	PESU & DIPT (0.165, 15, 0.526)	PESU & DIPT (-0.201, 15, 0.440)	PESU & DIPT (0.311, 12, 0.279)
	PESU & EPHE (NA, NA, NA)	PESU & EPHE (NA, NA, NA)	PESU & EPHE (NA, NA, NA)	PESU & EPHE (NA, NA, NA)
	PESU & HEMI (0.141, 12, 0.631)	PESU & HEMI (-0.175, 15, 0.502)	PESU & HEMI (0.389, 15, 0.122)	PESU & HEMI (0.222, 12, 0.446)
	PESU & HYME (0.104, 12, 0.725)	PESU & HYME (0.053, 15, 0.840)	PESU & HYME (-0.399, 15, 0.113)	PESU & HYME (0.266, 12, 0.358)
	PESU & LEPI (NA, NA, NA)	PESU & LEPI (NA, NA, NA)	PESU & LEPI (-0.121, 15, 0.644)	PESU & LEPI (0.096, 12, 0.745)
	PESU & ORTH (NA, NA, NA)	PESU & ORTH (-0.137, 15, 0.600)	PESU & ORTH (-0.092, 15, 0.726)	PESU & ORTH (0.084, 12, 0.775)
	PESU & TRIC (-0.077, 12, 0.794)	PESU & TRIC (NA, NA, NA)	PESU & TRIC (-0.221, 15, 0.394)	PESU & TRIC (-0.229, 12, 0.432)
	PESU & SHAN (-0.034, 12, 0.907)	PESU & SHAN (0.422, 15, 0.092)	PESU & SHAN (-0.469, 15, 0.0578)	PESU & SHAN (0.032, 12, 0.914)
Rural	EPFU & BLAT (NA, NA, NA)	EPFU & BLAT (-0.310, 13, 0.262)	EPFU & BLAT (NA, NA, NA)	EPFU & BLAT (NA, NA, NA)
	EPFU & COLE (-0.098, 14, 0.717)	EPFU & COLE (0.085, 13, 0.763)	EPFU & COLE (0.208, 14, 0.440)	EPFU & COLE (0.357, 12, 0.210)
	EPFU & DIPT (-0.038, 14, 0.890)	EPFU & DIPT (0.412, 13, 0.127)	EPFU & DIPT (-0.070, 14, 0.798)	EPFU & DIPT (0.315, 12, 0.273)

EPFU & EPHE (NA, NA, NA)	EPFU & EPHE (NA, NA, NA)	EPFU & EPHE (-0.364, 14, 0.166)	EPFU & EPHE (NA, NA, NA)
EPFU & HEMI (-0.146, 14, 0.590)	EPFU & HEMI (0.058, 13, 0.837)	EPFU & HEMI (0.093, 14, 0.732)	EPFU & HEMI (-0.068, 12, 0.817)
EPFU & HYME (0.077, 14, 0.778)	EPFU & HYME (0.308, 13, 0.263)	EPFU & HYME (0.219, 14, 0.416)	EPFU & HYME (-0.122, 12, 0.679)
EPFU & LEPI (NA, NA, NA)	EPFU & LEPI (0.400, 13, 0.262)	EPFU & LEPI (NA, NA, NA)	EPFU & LEPI (0.152, 12, 0.604)
EPFU & ORTH (NA, NA, NA)	EPFU & ORTH (NA, NA, NA)	EPFU & ORTH (-0.364, 14, 0.166)	EPFU & ORTH (NA, NA, NA)
EPFU & TRIC (-0.420, 14, 0.105)	EPFU & TRIC (0.297, 13, 0.282)	EPFU & TRIC (-0.263, 14, 0.324)	EPFU & TRIC (0.310, 12, 0.281)
EPFU & SHAN (-0.055, 14, 0.839)	EPFU & SHAN (0.231, 13, 0.408)	EPFU & SHAN (0.012, 14, 0.966)	**EPFU & SHAN (0.552, 12, 0.041)***
PESU & BLAT (NA, NA, NA)	PESU & BLAT (0.063, 13, 0.823)	PESU & BLAT (NA, NA, NA)	PESU & BLAT (NA, NA, NA)
PESU & COLE (-0.029, 14, 0.914)	PESU & COLE (0.453, 13, 0.090)	**PESU & COLE (-0.537, 14, 0.032)***	PESU & COLE (-0.106, 12, 0.718)
PESU & DIPT (-0.211, 14, 0.433)	**PESU & DIPT (0.552, 13, 0.033)***	PESU & DIPT (0.269, 14, 0.314)	PESU & DIPT (-0.248, 12, 0.393)
PESU & EPHE (NA, NA, NA)	PESU & EPHE (NA, NA, NA)	PESU & EPHE (-0.252, 14, 0.346)	PESU & EPHE (NA, NA, NA)
PESU & HEMI (-0.610, 14, 0.013)*	**PESU & HEMI (0.568, 13, 0.027)***	PESU & HEMI (-0.212, 14, 0.430)	PESU & HEMI (0-0.063, 12, 0.830)
PESU & HYME (0.239, 14, 0.373)	PESU & HYME (0.502, 13, 0.057)	PESU & HYME (0.084, 14, 0.757)	PESU & HYME (-0.012, 12, 0.969)
PESU & LEPI (NA, NA, NA)	PESU & LEPI (0.158, 13, 0.575)	PESU & LEPI (NA, NA, NA)	PESU & LEPI (0.518, 12, 0.058)
PESU & ORTH (NA, NA, NA)	PESU & ORTH (NA, NA, NA)	PESU & ORTH (-0.252, 14, 0.346)	PESU & ORTH (NA, NA, NA)
PESU & TRIC (-0.215, 14, 0.424)	PESU & TRIC (0.438, 13, 0.103)	PESU & TRIC (-0.119, 14, 0.661)	PESU & TRIC (-0.317, 12, 0.270)

PESU & SHAN (-0.180, 14, 0.505)	PESU & SHAN (0.146, 13, 0.605)	**PESU & SHAN (-0.640, 14, 0.008)***	PESU & SHAN (-0.065, 12, 0.825)

Table 18.—Dependent and independent variables and their measurement units are presented in each part of the urban-rural gradient. Variable averages are presented as mean ± (SE).

Variable	Urban (n=383)	Suburban (n=413)	Rural (n=406)
Big brown (calls/night)	182.66 (21.98)	27.35 (4.36)	61.61 (6.14)
Little brown (calls/night)	0.05 (0.02)	0.05 (0.02)	0.1 (0.03)
Northern long-eared (calls/night)	0 (0)	0.04 (0.02)	0 (0)
Tri-colored (calls/night)	5.63 (1.88)	0.57 (0.09)	3.19 (0.45)
Total bat (calls/night)	188.33 (22.09)	28.0 (4.36)	64.94 (6.17)
Light (lumens/ft²)	96.28 (10.98)	142.79 (15.19)	128.1 (12.54)
Sound (dBA)	46.99 (0.44)	42.71 (0.41)	41.16 (0.38)
Temperature (Celsius)	17.79 (0.33)	17.79 (0.31)	17.23 (0.30)
Humidity (%)	77.69 (0.78)	80.68 (0.7)	79.84 (0.81)
Barometric pressure (Hg)	29.87 (0.01)	29.71 (0.02)	29.91 (0.01)
Wind (mph)	5.63 (0.18)	5.55 (0.17)	5.51 (0.18)
Precipitation (inches)	0.15 (0.03)	0.07 (0.01)	0.08 (0.02)
Total insects (count/week)	54.22 (2.94)	61.71 (5.03)	59.22 (2.76)
Insect Shannon H (calculation)	0.95 (0.02)	0.94 (0.02)	1.08 (0.01)
Blatteodea (count/week)	0.09 (0.04)	0.01 (0.01)	0.02 (0.01)
Coleoptera (count/week)	3.05 (0.19)	5.25 (0.47)	9.26 (0.51)
Diptera (count/week)	11.07 (0.88)	10.82 (0.67)	18.19 (1.28)
Hemiptera (count/week)	19.03 (1.13)	32.45 (4.94)	11.75 (0.91)
Hymenoptera (count/week)	15.25 (2.41)	9.99 (0.65)	15.93 (1.77)

Lepidoptera (count/week)	0.1 (0.03)	0.04 (0.01)	0.04 (0.01)
Orthoptera (count/week)	0.13 (0.04)	0.12 (0.02)	0.02 (0.01)
Trichoptera (count/week)	0.07 (0.04)	0.1 (0.02)	0.51 (0.09)
Lunar (%)	0.53 (0.02)	0.49 (0.02)	0.44 (0.02)
Distance to water (m)	212.72 (13.47)	641.98 (28.02)	266.5 (4.74)
Distance to light (m)	38.99 (0.78)	32.44 (0.97)	80.11 (2.57)
Distance to building (m)	45.49 (1.55)	31.35 (1.02)	80.11 (2.57)
Distance to edge (m)	30.42 (1.66)	38.85 (3.11)	36.65 (1.61)
Distance to tree (m)	5.3 (0.21)	4.08 (0.11)	7.15 (0.33)
Tree height (m)	20.6 (0.28)	11.88 (0.12)	15.39 (0.33)
Tree density (count)	61.99 (1.75)	38.44 (1.35)	25.86 (0.58)
DBH (cm)	58.01 (2.12)	44.06 (1.84)	25.95 (0.72)
Canopy cover (%)	57.54 (1.26)	71.67 (1.45)	42.01 (1.59)
Tree species (list)	red maple, sweetgum, Norway maple, black locust, red oak, tree of heaven	black cherry, tulip tree, sweetgum, black walnut, black locust, red oak	white pine, red oak, sweetgum, sycamore