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Wildlife Research

Supplementary Material

Effects of multiple aspects of anthropogenic landscape change on mesopredator relative abundance

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Supplementary Tables and Figures

Supplementary Table 1. Means and ranges of landscape variables at spotlight survey segments. Segments were 1.6 km long, and were run between March 2nd and May 16th from 1981 to 2017 throughout Illinois.

Name	Mean	Range
Proportion of urban land cover	0.03	0 - 0.28
Proportion of agricultural land cover	0.63	0.01 - 0.97
Proportion of forest cover	0.26	0 - 0.89
Proportion of water	0.05	0 - 0.96
Housing density	3.35	0 - 230.22
Road density	0.07	0 - 6.1
Probability of honeysuckle	0.13	0.02 - 0.49
Probability of autumn olive	0.05	0.01 - 0.21
Probability of buckthorn	0.01	0 - 0.33
Probability of multiflora rose	0.15	0.02 - 0.5
Probability of invasive species	0.23	0.06 - 0.59

Supplementary Table 2. Summary of local-scale and landscape-scale variables modeled and the possible anthropogenic landscape change drivers of mesopredator relative abundance with which they are associated.

Variable name	Change driver name
Null	Other
Longitude × latitude	Other
Proportion of urban landcover (local)	Urban landcover
Proportion of urban landcover (landscape)	Urban landcover
Proportion of agriculture (local)	Agriculture
Proportion of agriculture (landscape)	Agriculture
Proportion of forest (local)	Forest
Proportion of forest (landscape)	Forest
Proportion of water (local)	Water
Proportion of water (landscape)	Water
Housing density (local)	Human structures
Housing density (landscape)	Human structures
Road density (local)	Human structures
Road density (landscape)	Human structures
Probability of honeysuckle (local)	Invasive species

Probability of honeysuckle (landscape)	Invasive species
Probability of autumn olive (local)	Invasive species
Probability of autumn olive (landscape)	Invasive species
Probability of buckthorn (local)	Invasive species
Probability of buckthorn (landscape)	Invasive species
Probability of multiflora rose (local)	Invasive species
Probability of multiflora rose (landscape)	Invasive species
Probability of invasive species (local)	Invasive species
Probability of invasive species (landscape)	Invasive species

Supplementary Table 3. Coefficients, standard errors, and z values and p values for Wald tests for coefficients of skunk model with greatest AIC support (local-scale proportion of forest cover and landscape-scale probability of autumn olive presence).

	Estimate	Std. Error	z value	Pr(>|z|)
Intercept	-2.99814	0.12506	-23.97399	0.00000
Proportion of forest cover (local)	-0.21277	0.03978	-5.34848	0.00000
Probability of autumn olive (landscape)	0.39938	0.12450	3.20796	0.00134
Year	0.13146	0.03994	3.29160	0.00100
Year^2	-0.20332	0.04349	-4.67548	0.00000
Mile	-0.03981	0.03771	-1.05583	0.29104
Mile^2	-0.09885	0.04113	-2.40333	0.01625
Average humidity	0.04815	0.03725	1.29265	0.19613
Average humidity^2	0.06056	0.02320	2.61083	0.00903
Average temperature	0.00505	0.04178	0.12087	0.90380
Average temperature^2	-0.10238	0.03536	-2.89501	0.00379
Day of year	-0.02237	0.03754	-0.59570	0.55138
Day of year^2	-0.01698	0.02527	-0.67193	0.50163

Supplementary Table 4. Coefficients, standard errors, and z values and p values for Wald tests for coefficients of opossum model with greatest AIC support (stop-level probability of Rosa multiflora presence and route-level probability of autumn olive presence).

	Estimate	Std. Error	z value	Pr(>|z|)
Intercept	-2.10980	0.08203	-25.72035	0.00000
Probability of multiflora rose (local)	0.06637	0.02084	3.18560	0.00144
Probability of autumn olive (landscape)	0.59050	0.08598	6.86765	0.00000
Year	0.17042	0.02113	8.06358	0.00000
Year^2	0.07170	0.02364	3.03311	0.00242
Mile	0.02528	0.02103	1.20212	0.22932
Mile^2	-0.06319	0.02338	-2.70228	0.00689
Average humidity	0.05780	0.02287	2.52719	0.01150
Average humidity^2	0.01801	0.01547	1.16383	0.24449
Average temperature	0.01537	0.02424	0.63404	0.52606
Average temperature^2	-0.09605	0.02032	-4.72644	0.00000
Day of year	-0.05617	0.02139	-2.62586	0.00864
Day of year^2	-0.00349	0.01418	-0.24614	0.80557

Supplementary Table 5. Coefficients, standard errors, and z values and p values for Wald tests for coefficients of raccoon model with greatest AIC support (local-scale proportion of agricultural land cover and landscape-scale proportion of agricultural land cover).

	Estimate	Std. Error	z value	Pr(>|z|)
Intercept	0.10097	0.06365	1.58634	0.11266
Proportion of agriculture (local)	-0.06223	0.00735	-8.46196	0.00000
Proportion of agriculture (landscape)	0.19176	0.05698	3.36551	0.00076
Year	0.07821	0.00737	10.61809	0.00000
Year^2	0.06783	0.00813	8.34532	0.00000
Mile	-0.02110	0.00737	-2.86118	0.00422
Mile^2	-0.07766	0.00819	-9.48169	0.00000
Average humidity	-0.00869	0.00783	-1.11073	0.26669
Average humidity^2	0.00525	0.00484	1.08326	0.27869
Average temperature	0.00746	0.00812	0.91912	0.35803
Average temperature^2	-0.01498	0.00666	-2.25063	0.02441
Day of year	0.02426	0.00748	3.24166	0.00119
Day of year^2	-0.01385	0.00484	-2.85959	0.00424

Supplementary Table 6. The number of parameters (K), AIC values, ΔAIC, and AIC weights (w) for all models for relative abundance of striped skunks. K is the number of parameters in each model. Δ AIC is calculated by subtracting each AIC value from the minimum AIC value, and AIC weight is calculated as $w_m = \frac{e^{-0.5*\Delta AIC_m}}{\sum_{m \in M} e^{-0.5*\Delta AIC_m}}$ *for each model m. The "null" model is a model with survey covariates (year, day of year, average temperature, etc.) with no landscape covariates.*

	K	AIC	ΔAIC	w
Proportion of forest (local) + probability of autumn olive (landscape)	14	6158.50	0.00	0.72
Proportion of forest (local) x probability of autumn olive (landscape)	15	6160.50	2.00	0.26
Proportion of forest (local)	13	6166.20	7.70	0.02
Probability of honeysuckle (local)	13	6170.52	12.02	0.00
Probability of invasive species (local)	13	6171.19	12.68	0.00
Probability of multiflora rose (local)	13	6171.42	12.92	0.00
Proportion of agriculture (local)	13	6172.29	13.79	0.00
Probability of buckthorn (local)	13	6173.42	14.92	0.00
Probability of autumn olive (landscape)	13	6185.72	27.22	0.00
Road density (local)	13	6188.67	30.16	0.00
Longitude x latitude	15	6188.97	30.46	0.00
Proportion of urban landcover (landscape)	13	6190.54	32.04	0.00

Housing density (landscape)	13	6190.80	32.30	0.00
Probability of buckthorn (landscape)	13	6191.66	33.15	0.00
Probability of autumn olive (local)	13	6192.03	33.53	0.00
Proportion of water (local)	13	6192.06	33.56	0.00
Null	12	6193.37	34.87	0.00
Housing density (local)	13	6193.88	35.37	0.00
Proportion of agriculture (landscape)	13	6194.60	36.09	0.00
Probability of honeysuckle (landscape)	13	6194.69	36.19	0.00
Proportion of water (landscape)	13	6194.73	36.22	0.00
Probability of multiflora rose (landscape)	13	6194.95	36.44	0.00
Proportion of urban landcover (local)	13	6194.97	36.46	0.00
Proportion of forest (landscape)	13	6195.12	36.61	0.00
Probability of invasive species (landscape)	13	6195.17	36.66	0.00
Road density (landscape)	13	6195.37	36.87	0.00

Supplementary Table 7. The number of parameters (K), AIC values, ΔAIC, and AIC weights (w) for all models for relative abundance of Virginia opossums. K is the number of parameters in each model. Δ AIC is calculated by subtracting each AIC value from the minimum AIC value, and AIC weight is calculated as $w_m = \frac{e^{-0.5*\Delta AIC_m}}{\sum_{m \in M} e^{-0.5*\Delta AIC_m}}$ *for each model m. The "null" model is a model with survey covariates (year, day of year, average temperature, etc.) with no landscape covariates.*

	K	AIC	ΔAIC	w
Probability of multiflora rose (local) + probability of autumn olive (landscape)	14	13828.96	0.00	0.63
Probability of multiflora rose (local) x probability of autumn olive (landscape)	15	13830.27	1.31	0.33
Longitude x latitude	15	13834.72	5.76	0.04
Probability of autumn olive (landscape)	13	13836.95	7.98	0.01
Probability of honeysuckle (landscape)	13	13853.35	24.39	0.00
Proportion of agriculture (landscape)	13	13855.26	26.30	0.00
Proportion of forest (landscape)	13	13856.91	27.94	0.00
Probability of invasive species (landscape)	13	13858.37	29.40	0.00
Probability of multiflora rose (landscape)	13	13861.38	32.42	0.00
Proportion of agriculture (local)	13	13864.99	36.02	0.00
Probability of multiflora rose (local)	13	13865.01	36.04	0.00
Probability of invasive species (local)	13	13865.51	36.55	0.00

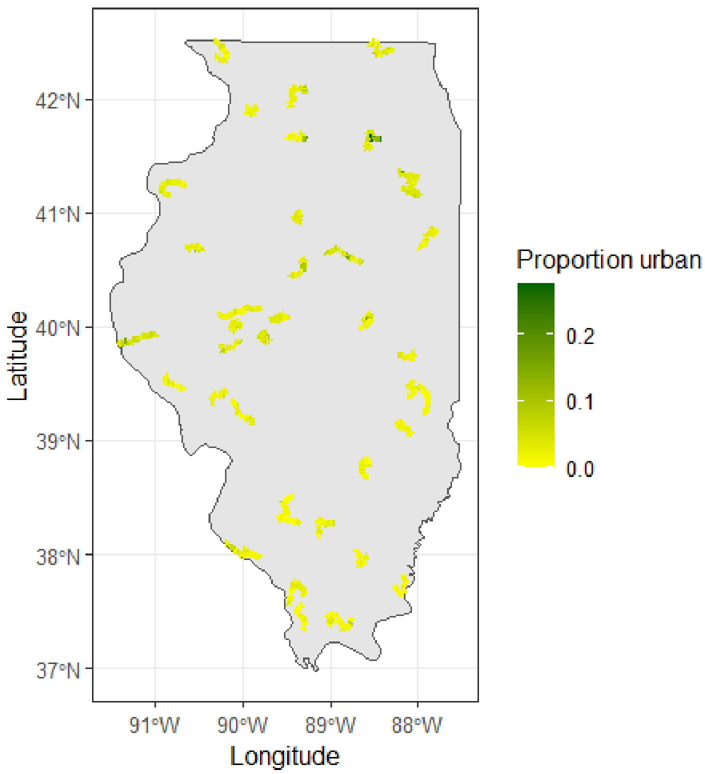
Probability of honeysuckle (local)	13	13865.53	36.57	0.00
Proportion of water (local)	13	13865.97	37.01	0.00
Probability of buckthorn (local)	13	13866.82	37.86	0.00
Probability of buckthorn (landscape)	13	13866.98	38.02	0.00
Probability of autumn olive (local)	13	13868.84	39.88	0.00
Housing density (landscape)	13	13871.84	42.87	0.00
Proportion of water (landscape)	13	13872.07	43.11	0.00
Proportion of forest (local)	13	13872.27	43.31	0.00
Proportion of urban landcover (landscape)	13	13872.50	43.54	0.00
Road density (landscape)	13	13872.71	43.75	0.00
Null	12	13872.93	43.97	0.00
Road density (local)	13	13873.75	44.79	0.00
Proportion of urban landcover (local)	13	13873.90	44.94	0.00
Housing density (local)	13	13874.32	45.36	0.00

Supplementary Table 8. The number of parameters (K), AIC values, ΔAIC, and AIC weights (w) for all models for relative abundance of northern raccoons. K is the number of parameters in each model. Δ AIC is calculated by subtracting each AIC value from the minimum AIC value, and AIC weight is calculated as $w_m = \frac{e^{-0.5*\Delta AIC_m}}{\sum_{m \in M} e^{-0.5*\Delta AIC_m}}$ *for each model m. The "null" model is a model with survey covariates (year, day of year, average temperature, etc.) with no landscape covariates.*

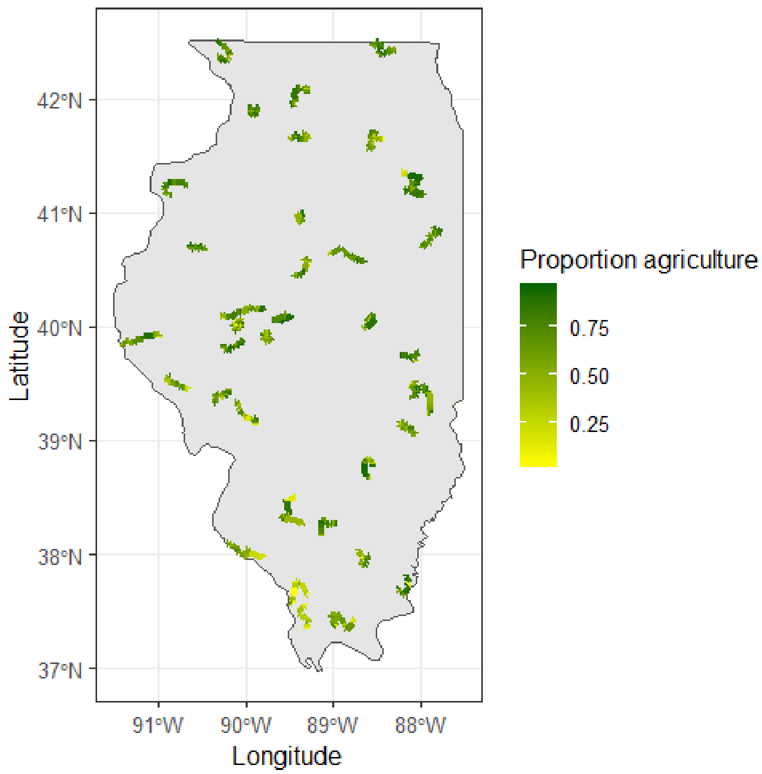
	K	AIC	ΔAIC	w
Proportion of agriculture (local) + proportion of agriculture (landscape)	14	52767.86	0.00	0.62
Proportion of agriculture (local) x proportion of agriculture (landscape)	15	52768.84	0.98	0.38
Proportion of agriculture (local)	13	52776.50	8.64	0.01
Probability of invasive species (local)	13	52785.07	17.22	0.00
Probability of honeysuckle (local)	13	52785.33	17.47	0.00
Probability of multiflora rose (local)	13	52786.05	18.20	0.00
Probability of buckthorn (local)	13	52788.34	20.48	0.00
Proportion of forest (local)	13	52801.77	33.92	0.00
Proportion of water (local)	13	52812.91	45.05	0.00
Probability of autumn olive (local)	13	52821.67	53.81	0.00
Longitude x latitude	15	52829.74	61.88	0.00
Proportion of agriculture (landscape)	13	52836.75	68.90	0.00

Road density (local)	13	52839.53	71.68	0.00
Proportion of urban landcover (local)	13	52842.14	74.28	0.00
Housing density (landscape)	13	52842.66	74.80	0.00
Probability of multiflora rose (landscape)	13	52844.92	77.07	0.00
Null	12	52845.39	77.53	0.00
Proportion of water (landscape)	13	52845.49	77.64	0.00
Probability of honeysuckle (landscape)	13	52846.00	78.14	0.00
Housing density (local)	13	52846.43	78.57	0.00
Proportion of forest (landscape)	13	52846.65	78.79	0.00
Road density (landscape)	13	52846.78	78.92	0.00
Proportion of urban landcover (landscape)	13	52846.93	79.07	0.00
Probability of autumn olive (landscape)	13	52847.10	79.25	0.00
Probability of buckthorn (landscape)	13	52847.33	79.47	0.00
Probability of invasive species (landscape)	13	52847.38	79.52	0.00

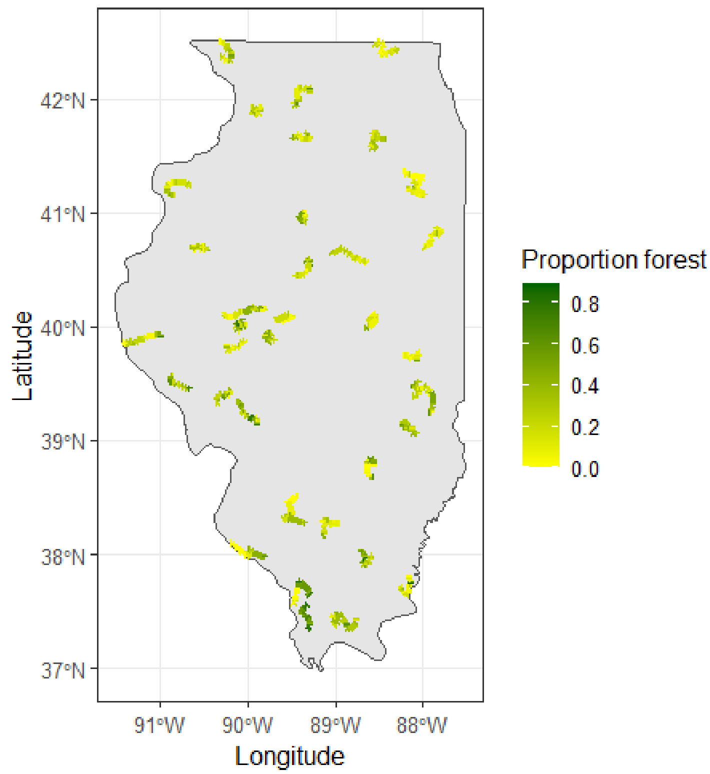
Supplementary Figure 1. Proportion of urban landcover for spotlight routes in Illinois in 2017. Proportions were calculated within 1.6-km buffers around the midpoints of each spotlight route segment.



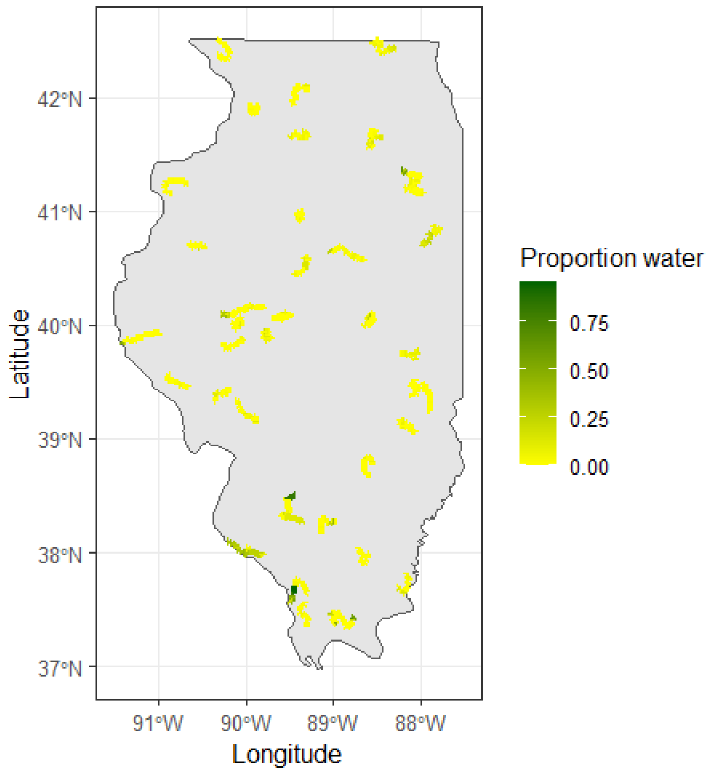
Supplementary Figure 2. Proportion of agricultural landcover for spotlight routes in Illinois in 2017. Proportions were calculated within 1.6-km buffers around the midpoints of each spotlight route segment.



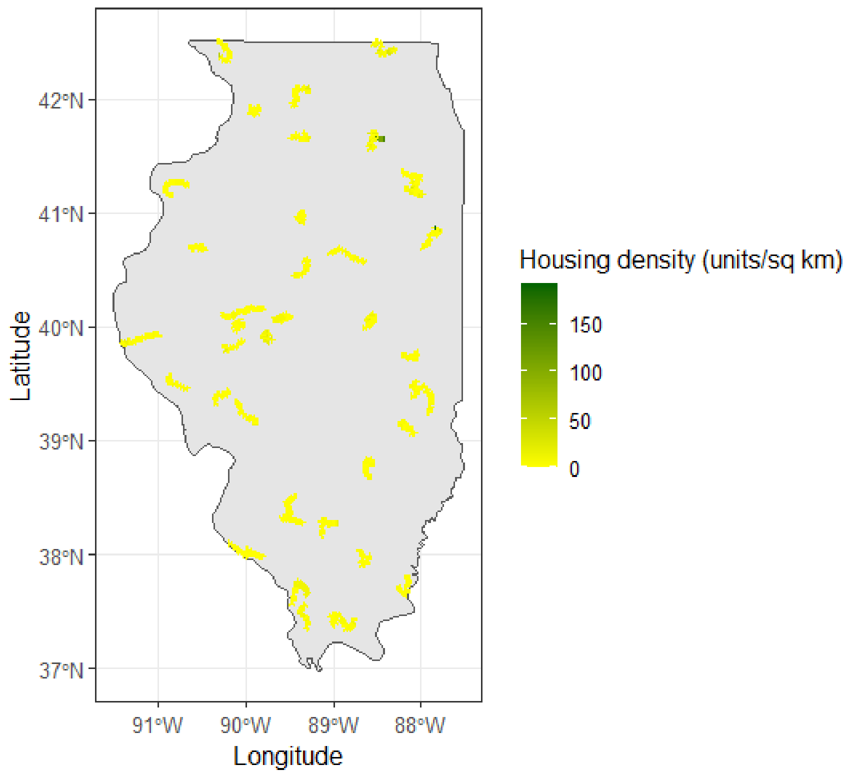
Supplementary Figure 3. Proportion of forest landcover for spotlight routes in Illinois in 2017. Proportions were calculated within 1.6-km buffers around the midpoints of each spotlight route segment.



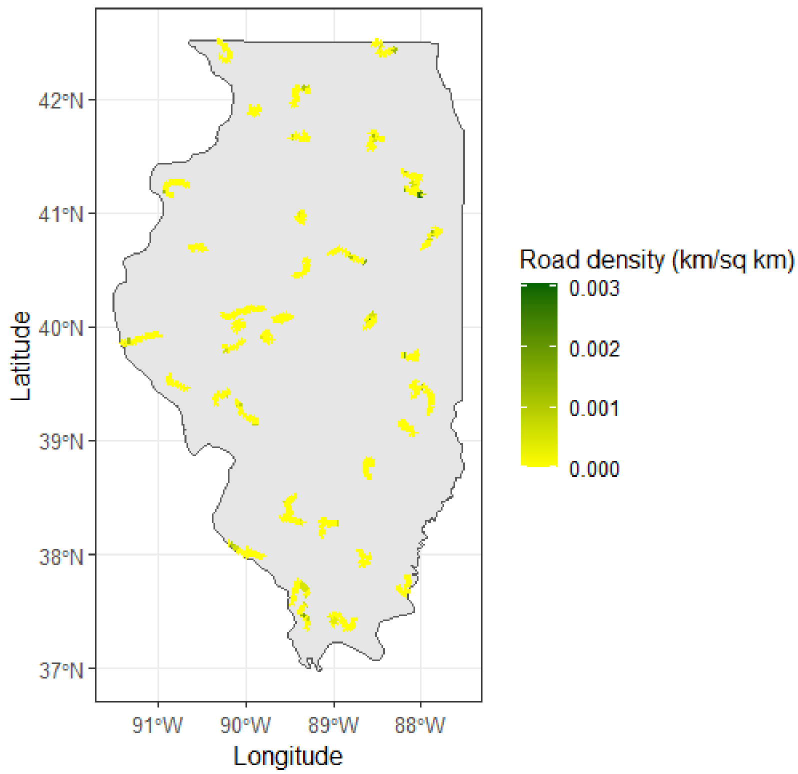
Supplementary Figure 4. Proportion of water landcover for spotlight routes in Illinois in 2017. Proportions were calculated within 1.6-km buffers around the midpoints of each spotlight route segment.



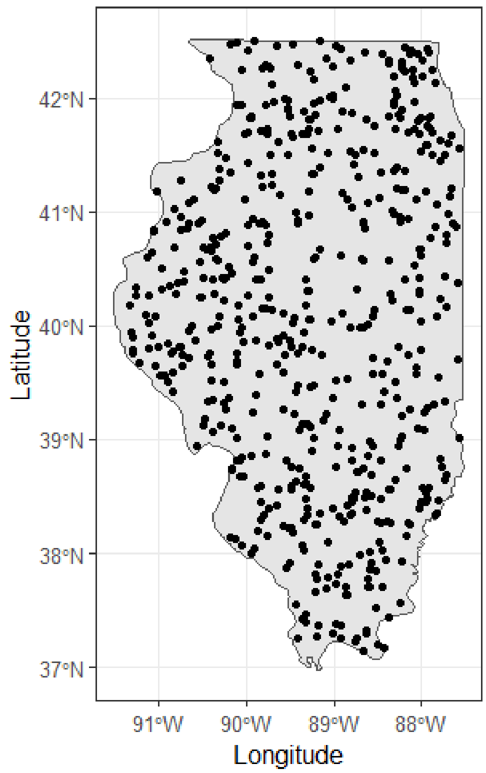
Supplementary Figure 5. Housing density (units/sq km) for spotlight routes in Illinois in 2017. Housing density was extracted within 1.6-km buffers around the midpoints of each spotlight route segment.



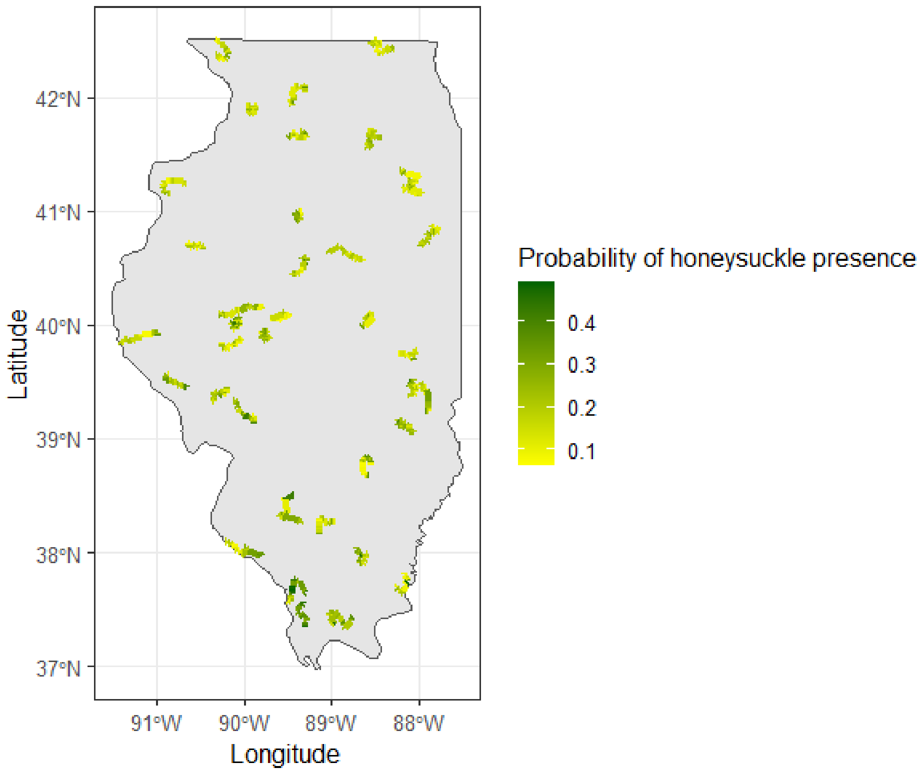
Supplementary Figure 6. Road density (km/sq km) for spotlight routes in Illinois in 2017. Road density was calculated within 1.6-km buffers around the midpoints of each spotlight route segment.



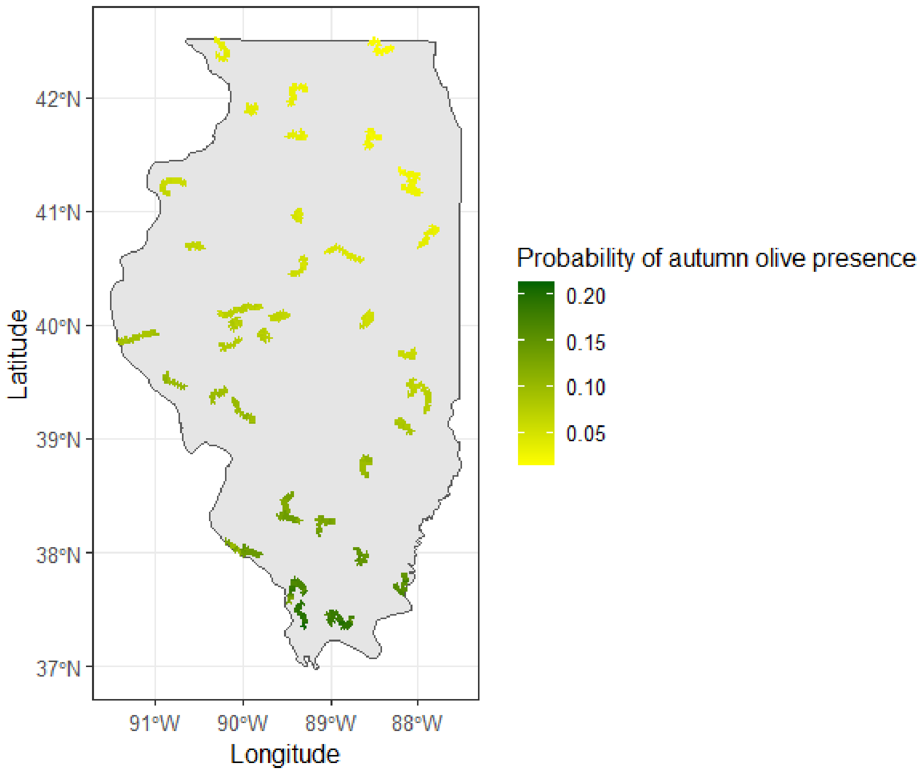
Supplementary Figure 7. Locations of Critical Trends Assessment Program (CTAP) sites in Illinois.



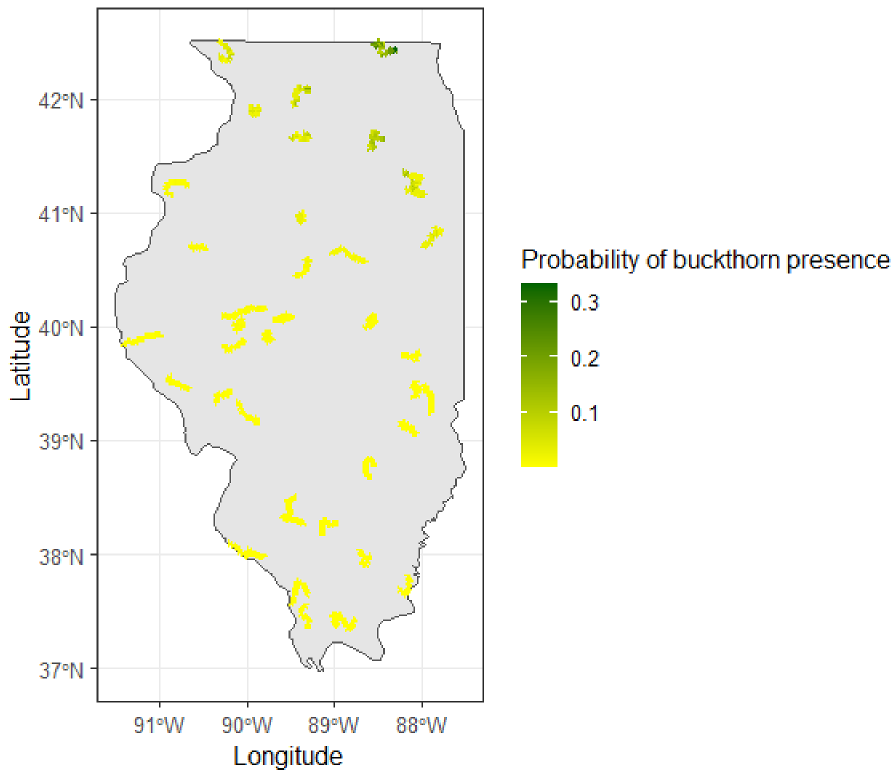
Supplementary Figure 8. Probability of honeysuckle presence for spotlight routes in Illinois in 2017. Probabilities were calculated from models fit to CTAP shrub occurrence data.



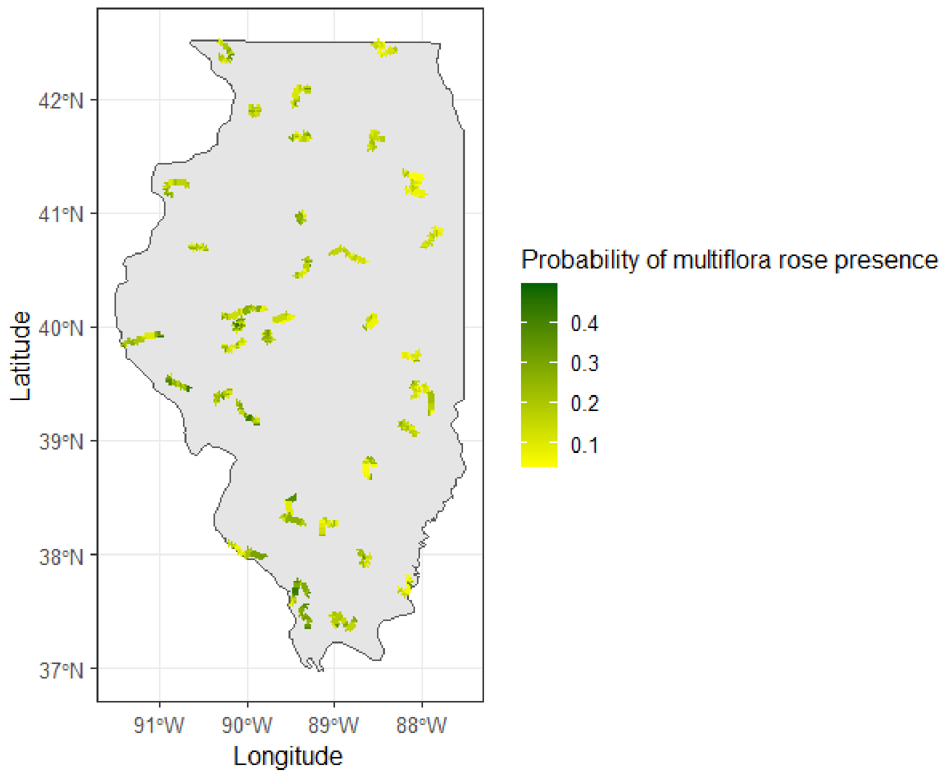
Supplementary Figure 9. Probability of autumn olive presence for spotlight routes in Illinois in 2017. Probabilities were calculated from models fit to CTAP shrub occurrence data.



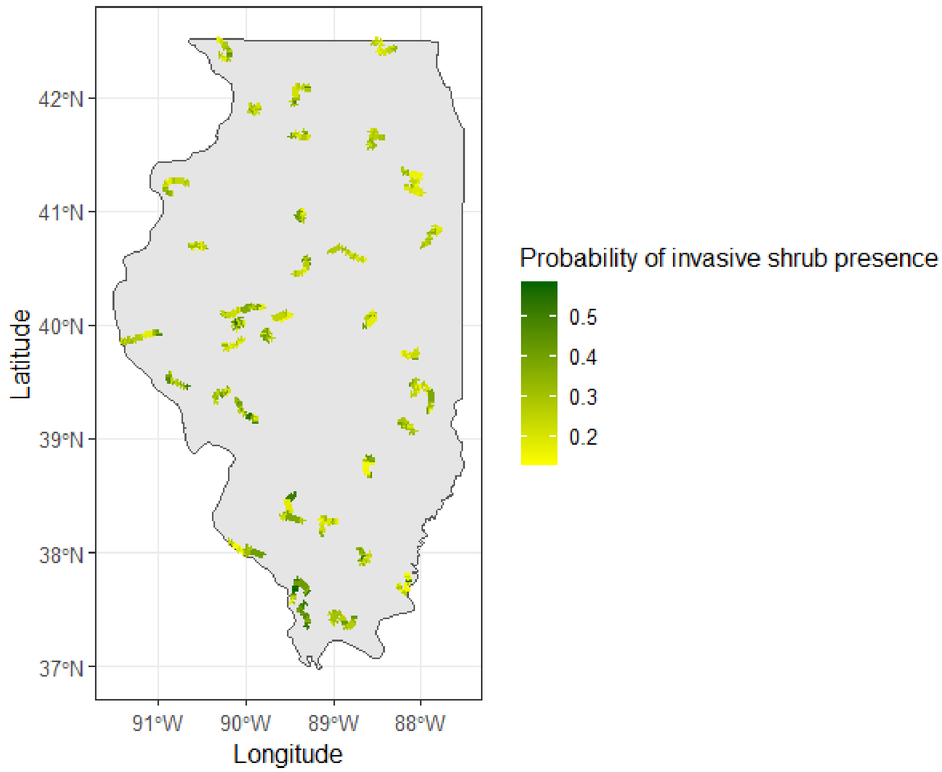
Supplementary Figure 10. Probability of buckthorn presence for spotlight routes in Illinois in 2017. Probabilities were calculated from models fit to CTAP shrub occurrence data.



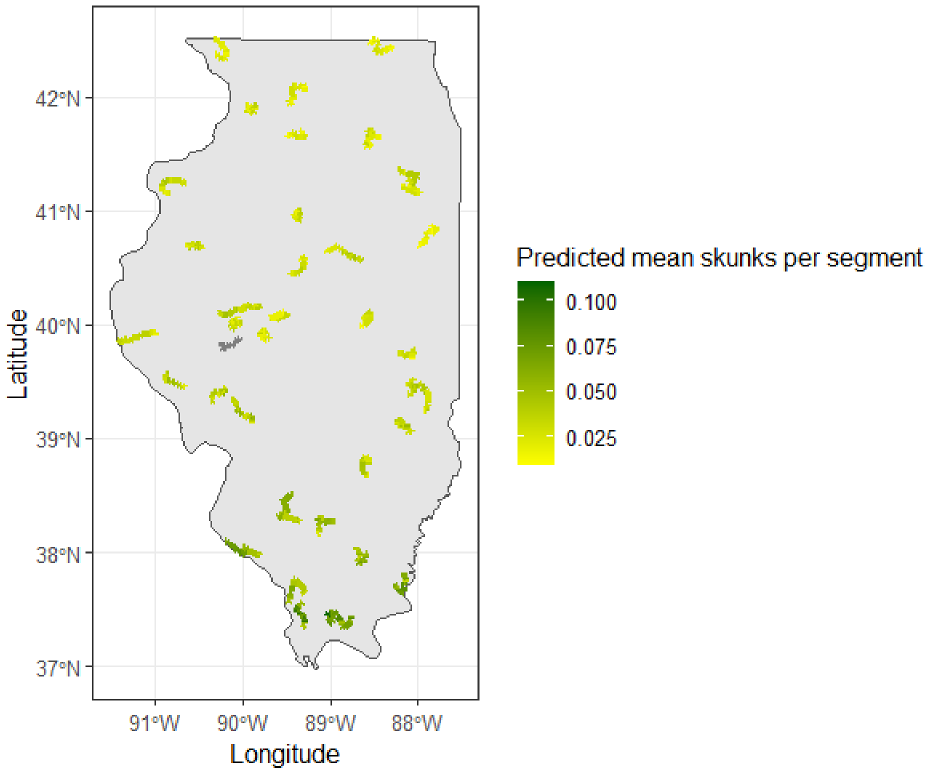
Supplementary Figure 11. Probability of multiflora rose presence for spotlight routes in Illinois in 2017. Probabilities were calculated from models fit to CTAP shrub occurrence data.



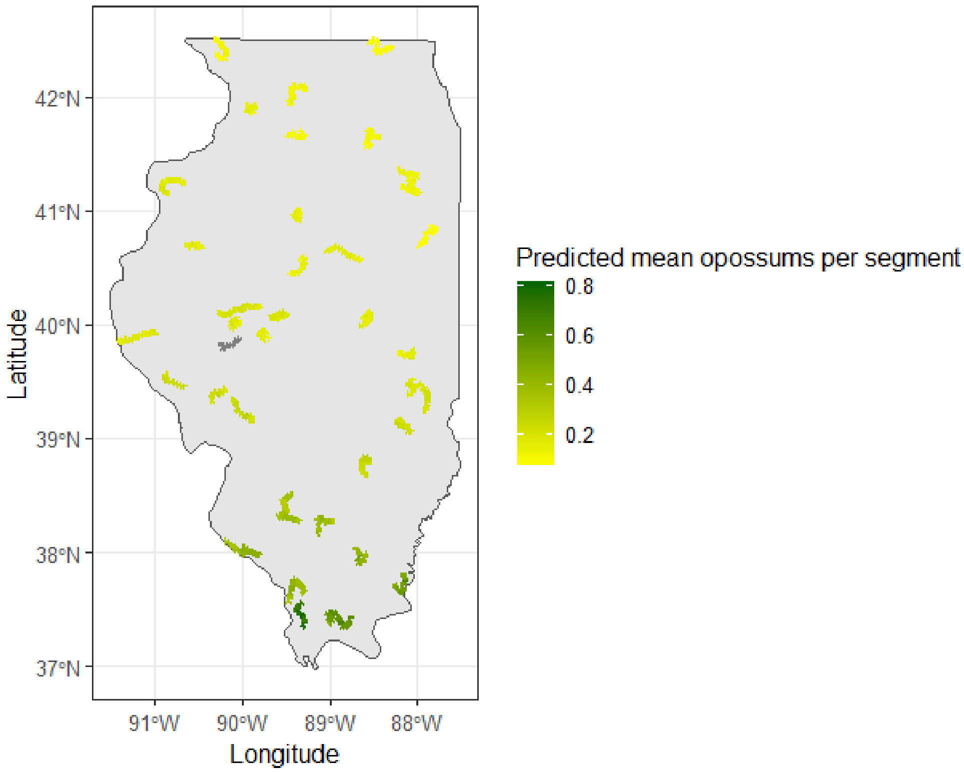
Supplementary Figure 12. Probability of any of the invasive shrubs' presence for spotlight routes in Illinois in 2017. Probabilities were calculated from models fit to CTAP shrub occurrence data.



Supplementary Figure 13. Predicted mean skunks per route segment for spotlight routes in Illinois in 2017. Predictions were made using 2017 landcover and segment- and route-specific data (e.g., temperature, segment of route surveyed) and the top model for skunk (local-scale proportion of forest and landscape-scale probability of autumn olive presence).



Supplementary Figure 14. Predicted mean opossums per route segment for spotlight routes in Illinois in 2017. Predictions were made using 2017 landcover and segment- and route-specific data (e.g., temperature, segment of route surveyed) and the top model for opossum (local-scale probability of multiflora rose presence and landscape-scale probability of autumn olive presence).



Supplementary Figure 15. Predicted mean raccoons per route segment for spotlight routes in Illinois in 2017. Predictions were made using 2017 landcover and segment- and route-specific data (e.g., temperature, segment of route surveyed) and the top model for raccoon (local-scale proportion of agriculture and landscape-scale proportion of agriculture).