

Supplementary Materials for

**Reduced human activity during COVID-19 alters avian land
use across North America**

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The PDF file includes:

Supplementary Text
Figs. S1 to S11
Tables S1 to S5
Legends for data S1 to S4

Other Supplementary Material for this manuscript includes the following:

Data S1 to S4

Supplementary Text

Model variables

Table S1 (p. 101) lists summary statistics for all the variables used in our models. Figures S1–S4 (pp. 3–6) and Table S2 (p. 102) describe the distribution of the distance traveled, duration, distance to road, distance to airport, and landcover (urban vs. rural) variables, and compares those distributions between the pre-pandemic and pandemic periods. The distribution of the change in traffic variable is displayed in the main text (Fig. 1A), and the overlap variable was specific to each species-by-county combination, and therefore not easily displayed (though, see Fig. 1B for a representative example).

Note that the model for each species only included a subset of counties, so the exact distribution of predictor data would have varied slightly for each.

Figures S5–S9 (pp. 7–11) compare the distributions of different predictors to assess collinearity.

Model results

Figures S10 (pp. 12–17) and S11 (pp. 18–100) are multi-page figures that present all of the 95% credible intervals and interaction plots (respectively) for all 82 species and all five interaction terms used in the study. Captions for Figs. S10 and S11 are placed on the page preceding each, on pp. 12 and 18, respectively.

Tables S3–S5 (pp. 103–105) relate to our post-hoc assessment of results in relation to independent measures of detection.

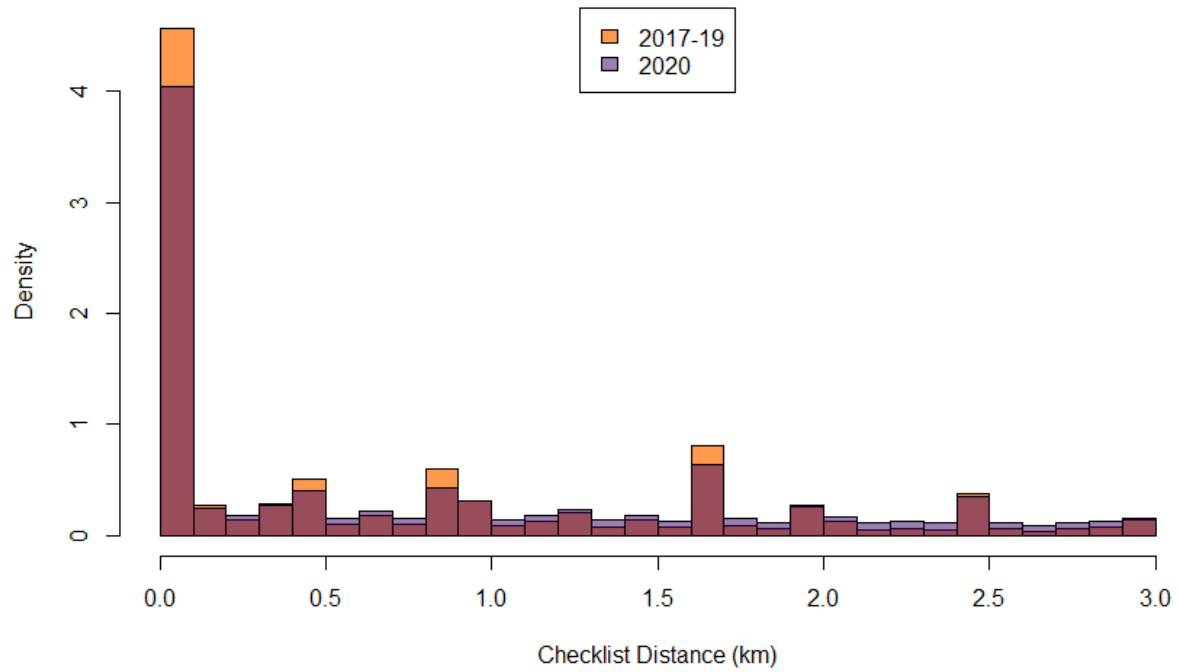


Fig. S1.

Distribution of distance traveled (in kilometers) recorded for all eBird checklists used in the analysis (from all counties), separated into the pre-pandemic and pandemic periods. The third color occurs where both histograms overlap.

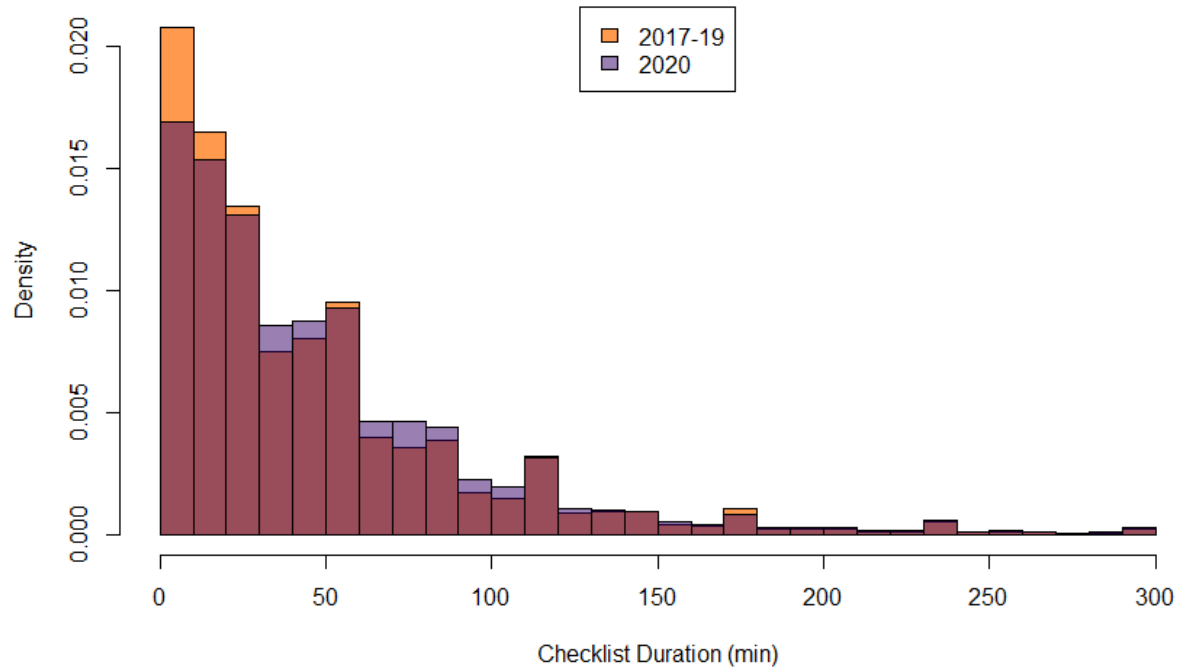


Fig. S2.

Distribution of duration (in minutes) recorded for all eBird checklists used in the analysis (from all counties), separated into the pre-pandemic and pandemic periods. The third color occurs where both histograms overlap.

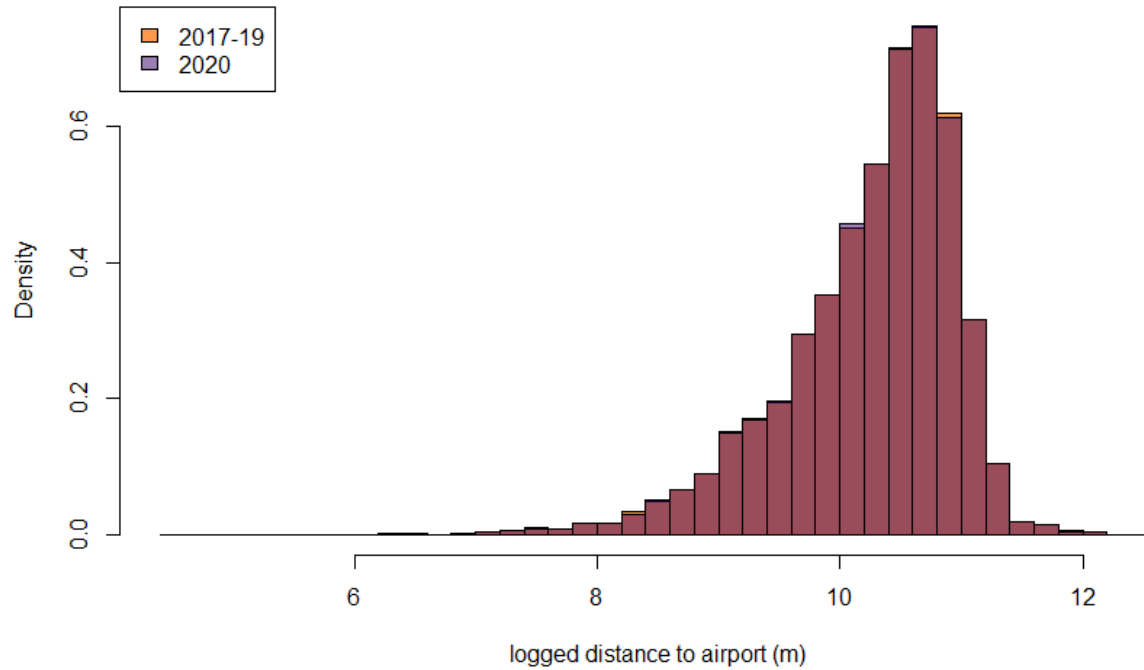


Fig. S3.

Distribution of logged distance to international airports recorded for all eBird checklists used in the analysis (from all counties), separated into the pre-pandemic and pandemic periods. The third color occurs where both histograms overlap.

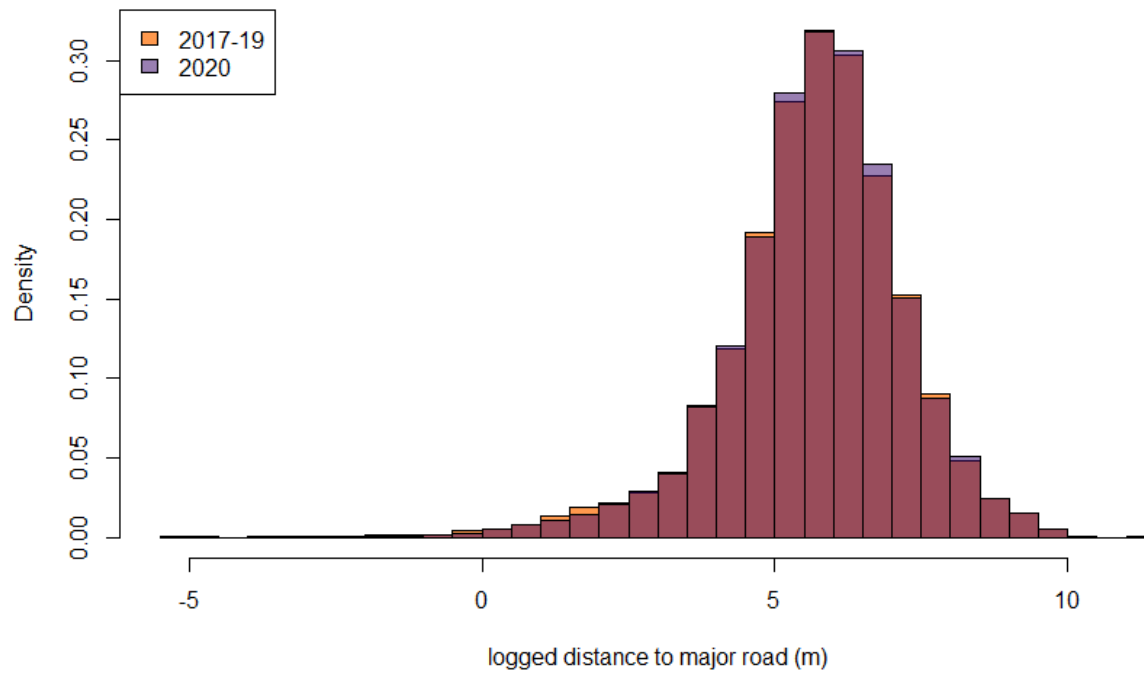


Fig. S4.

Distribution of logged distance to nearest major road recorded for all eBird checklists used in the analysis (from all counties), separated into the pre-pandemic and pandemic periods. The third color occurs where both histograms overlap.

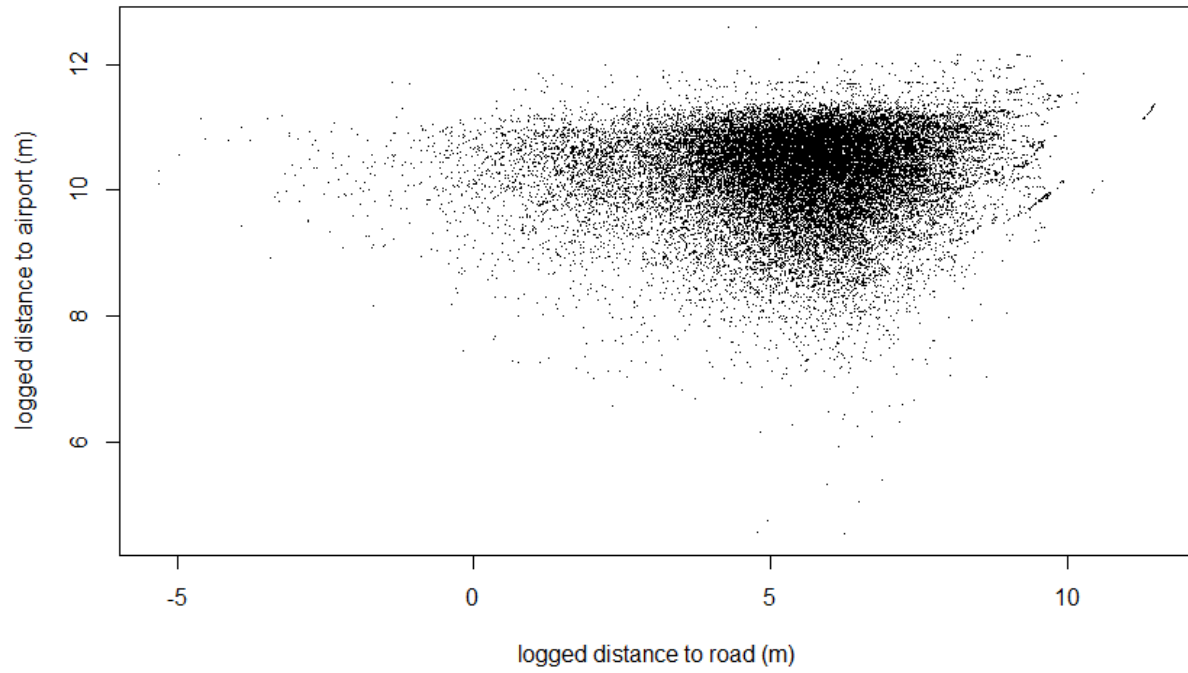


Fig. S5.

Plot of logged distance to road vs. logged distance to airport for all checklists. Pearson product moment correlation coefficient = 0.069 ($t = 20.4$, $df = 88604$, $p < 0.001$).

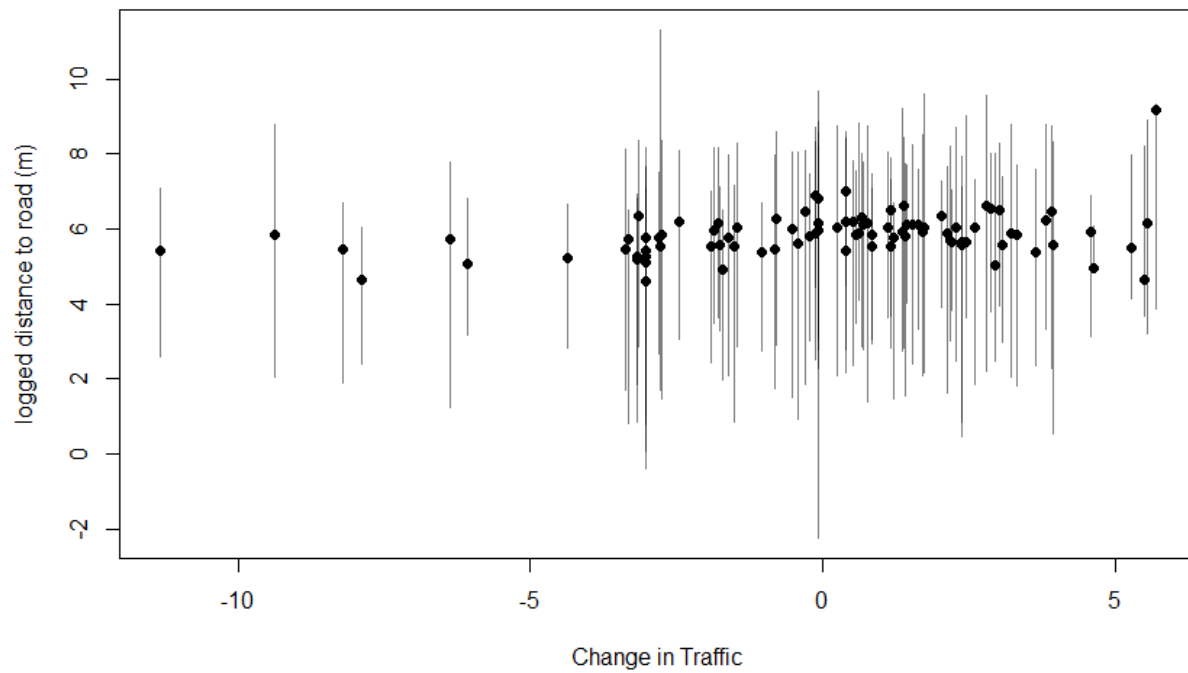


Fig. S6.

The relationship between the county-specific percent change in traffic during the pandemic (centered, such that 0 = the mean percent change) and the county-specific medians (points) and 2.5–97.5% quantiles (bars) of logged distance to major road.

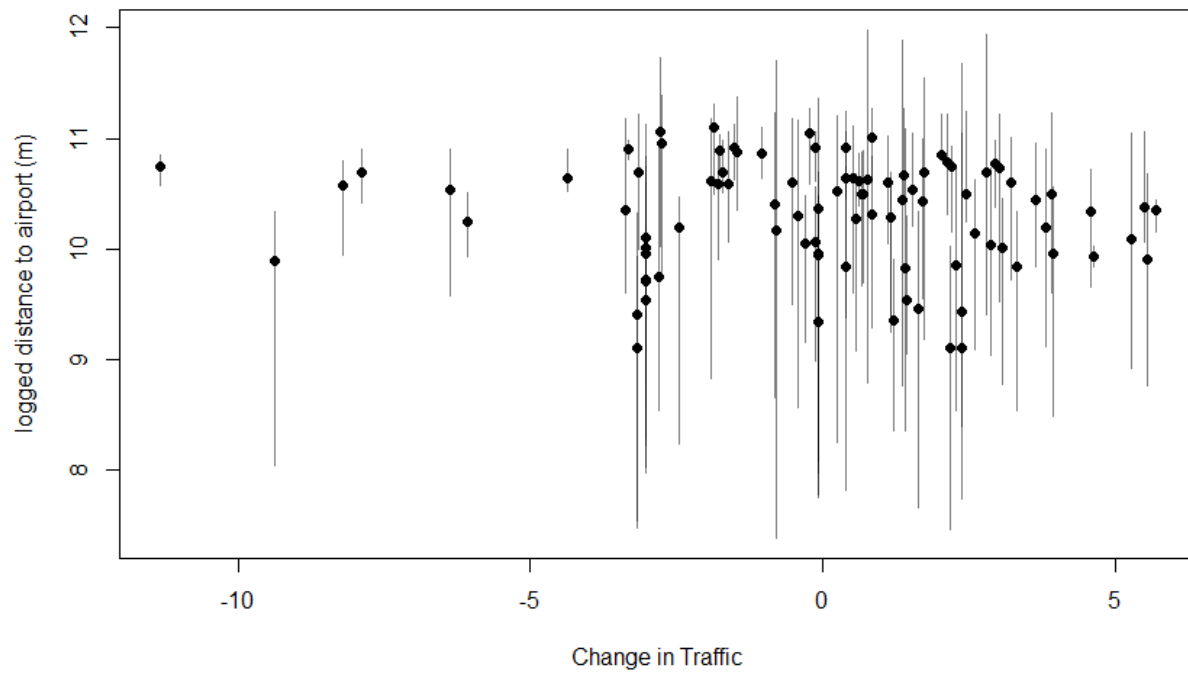


Fig. S7.

The relationship between the county-specific percent change in traffic during the pandemic (centered, such that 0 = the mean percent change) and the county-specific medians (points) and 2.5–97.5% quantiles (bars) of logged distance to airport.

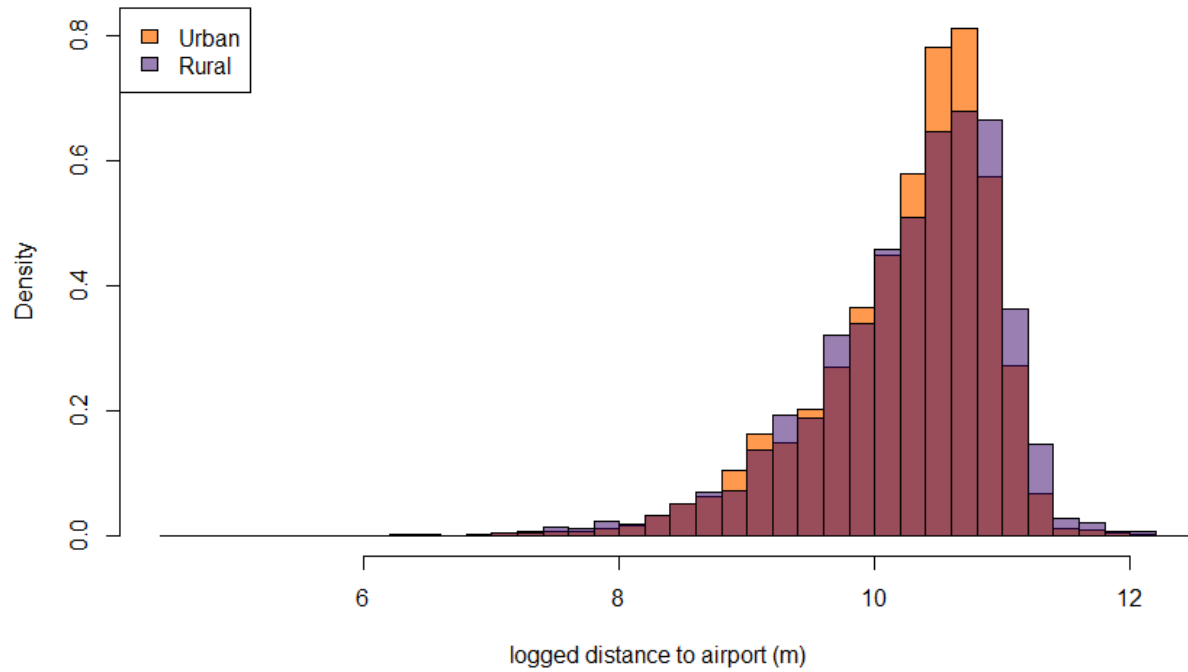


Fig. S8.

Distribution of logged distance to airport recorded for all eBird checklists used in the analysis (from all counties), separated into checklists coming from urban vs. rural habitat. The third color occurs where both histograms overlap.

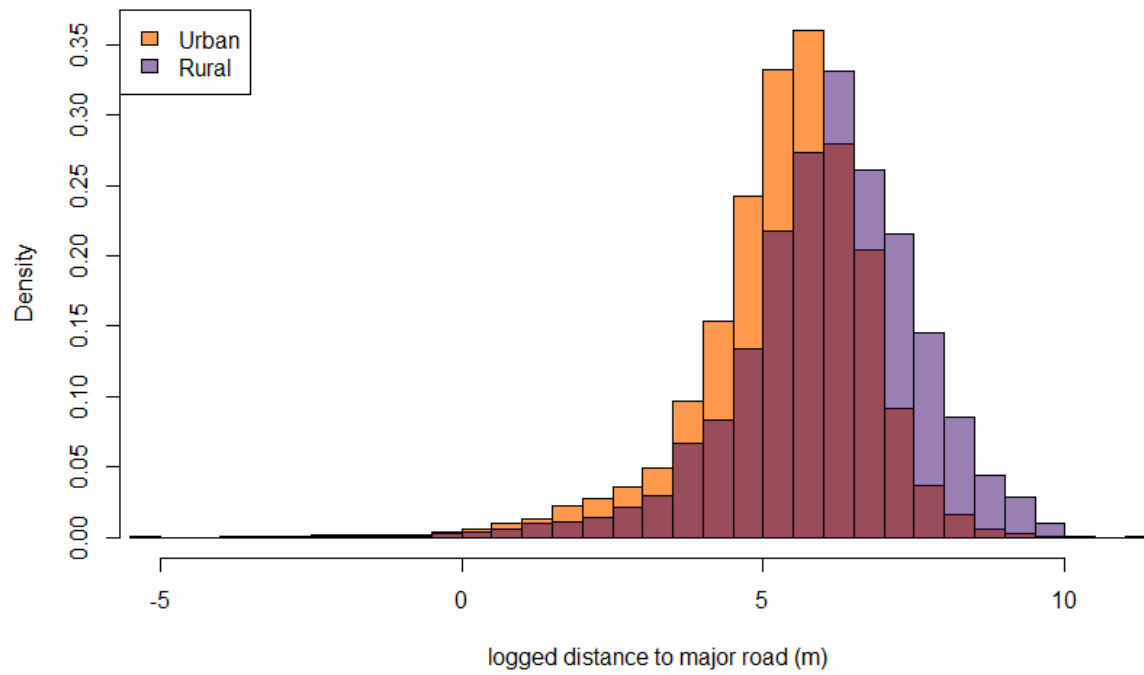


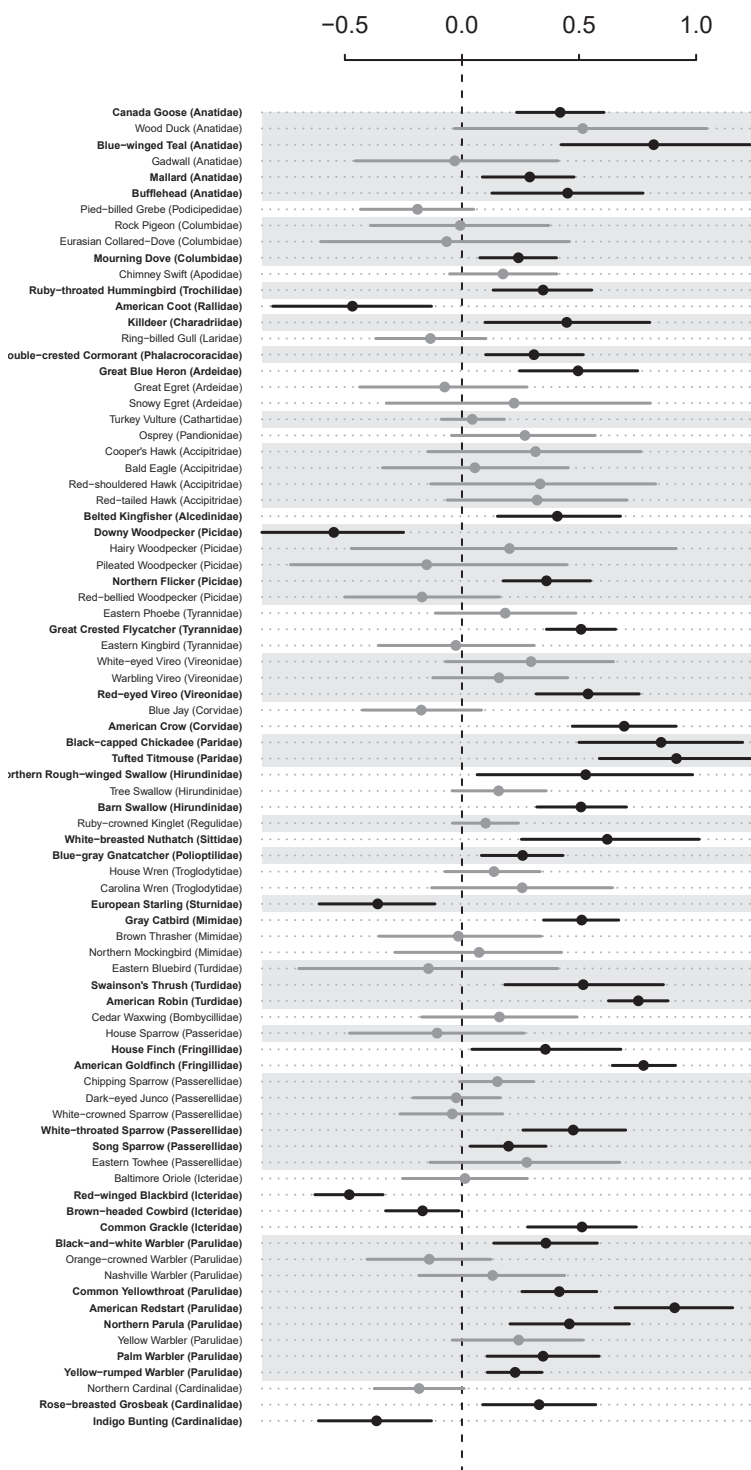
Fig. S9.

Distribution of logged distance to nearest major road recorded for all eBird checklists used in the analysis (from all counties), separated into checklists coming from urban vs. rural habitat. The third color occurs where both histograms overlap.

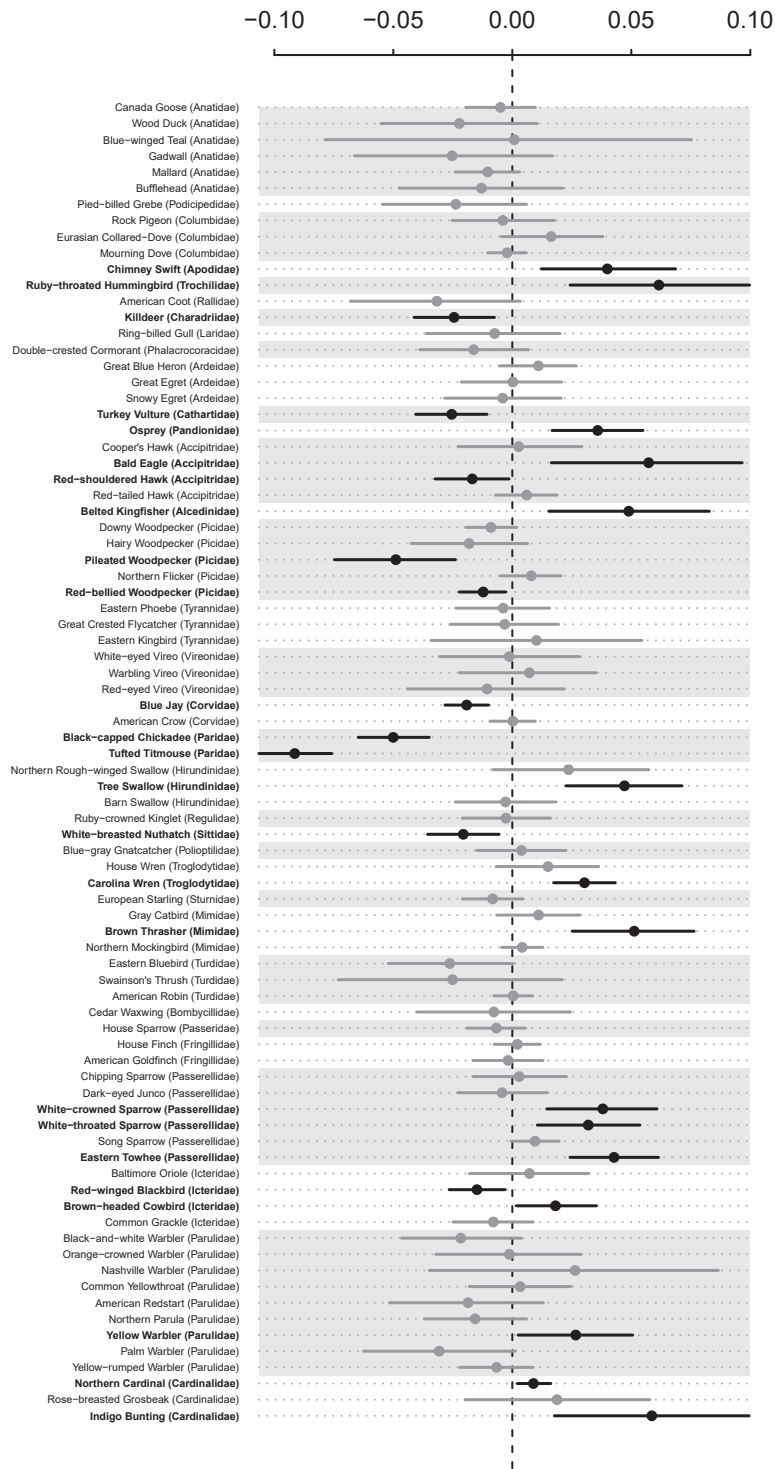
Fig. S10. (multi-page figure beginning on the next page)

Interaction coefficient posterior distributions. Medians and 95% credible intervals for all interaction coefficients for each species, labeled as: “overlap”: overlap between peak migration and peak travel reductions; “delta_traf”: percent change in human mobility during pandemic; “land” urban versus rural habitat; “air”: distance to airport, and “road”: distance to major road. Species with 95% credible intervals that do not overlap zero are in bold. For ease of comparison, the sign of all intervals has been transformed such that positive values indicate increases in counts in areas where human activity was reduced.

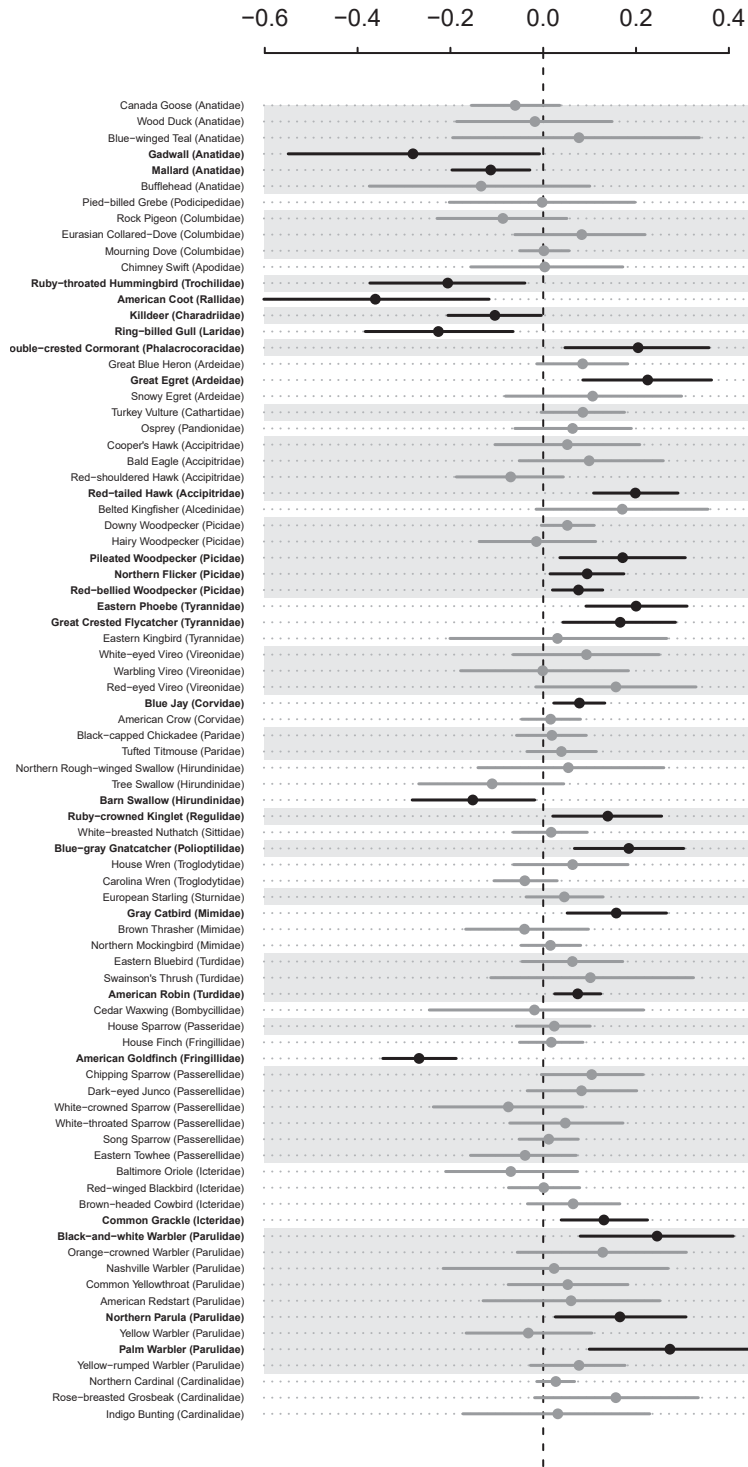
pandemic:overlap interaction



pandemic:delta_traf interaction

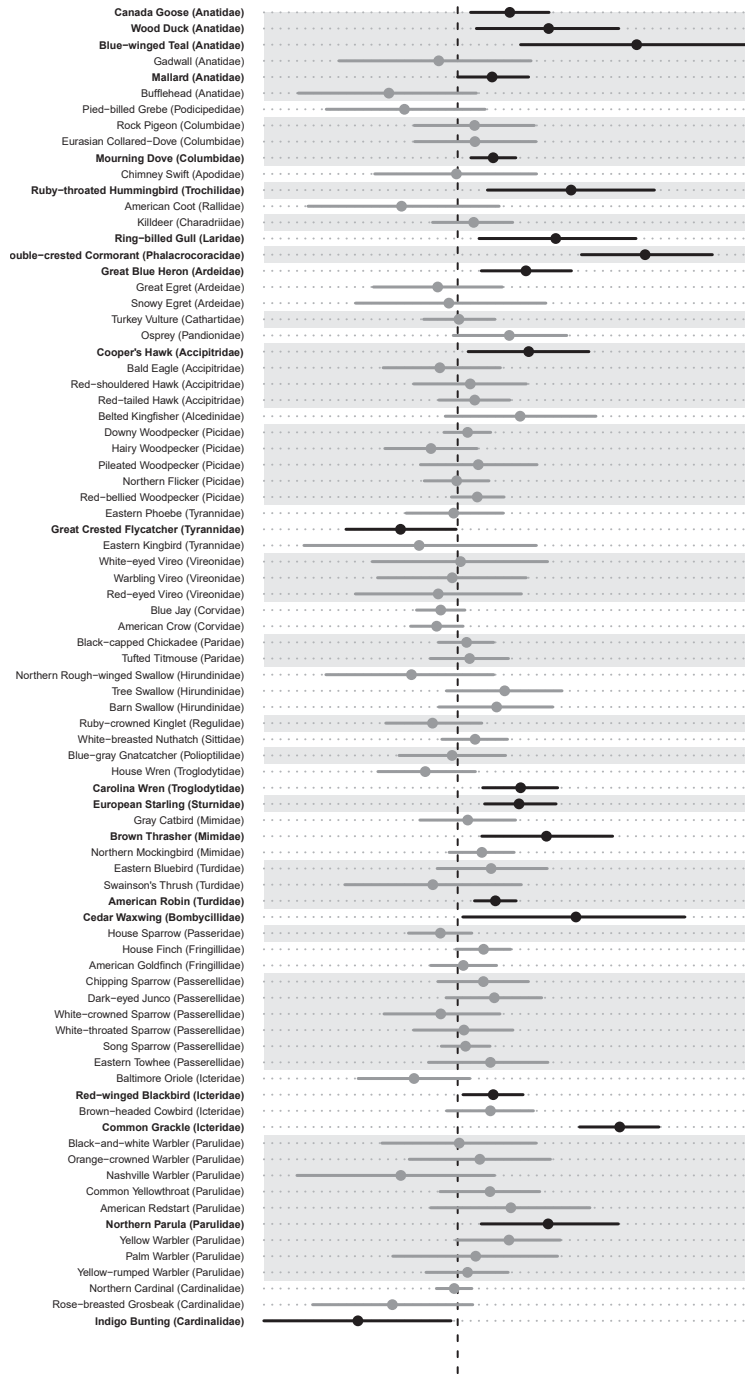


pandemic:land interaction



pandemic:air interaction

-0.2 0.0 0.2 0.4



pandemic:road interaction

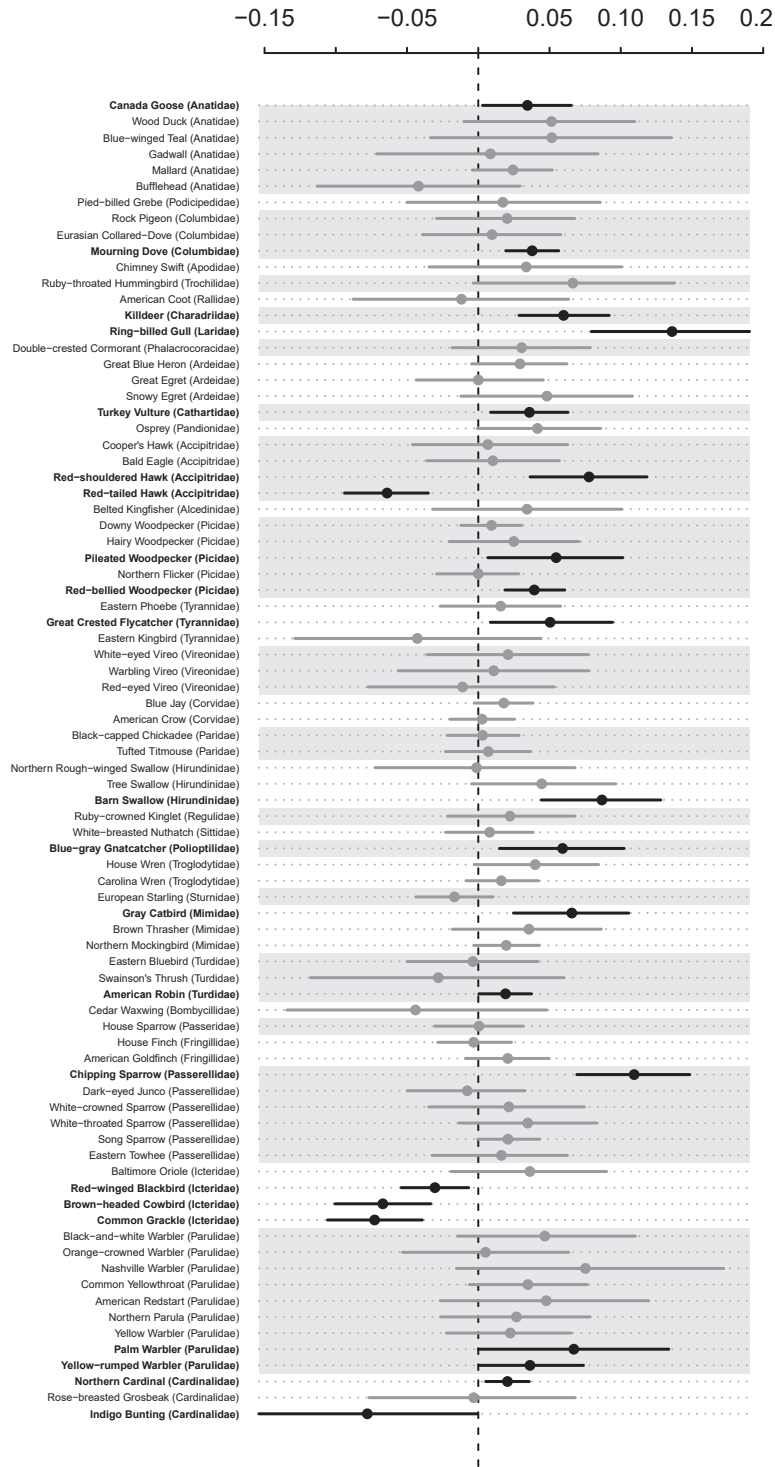
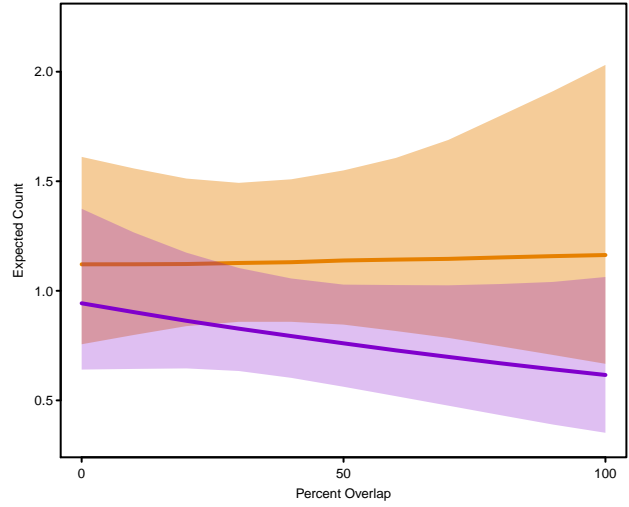
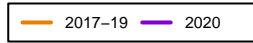


Fig. S11. (multi-page figure beginning on the next page)

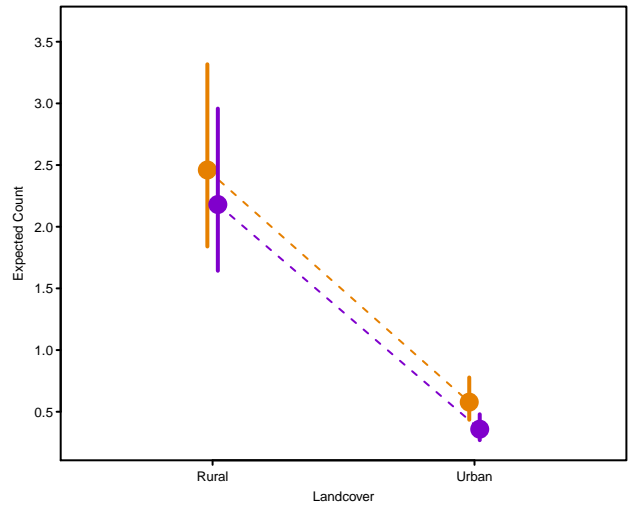
Interactions between period (pandemic/pre-pandemic) and focal variables describing pandemic-altered areas. Marginal predicted mean count (lines or points) including 95% credible interval (shaded areas or error bars) of the effect of the focal variable on bird counts during the COVID-19 pandemic (purple) compared to the pre-pandemic baseline period (orange) for all 82 North American focal species (arranged alphabetically by common name). To facilitate visualization of non-zero changes in relationship, plots are only included for interaction coefficients with 95% credible intervals not containing zero and are arranged as follows: (top right) overlap between peak migration and peak travel reductions, (center left) percent change in human mobility during pandemic, (center right) urban versus rural habitat, (bottom left) distance to airport, and (bottom right) distance to major road. Changes to human activity during the pandemic increase from left to right on each panel.

American Coot

Fulica americana



posterior distribution 95% CI
for interaction with
delta_traf includes zero

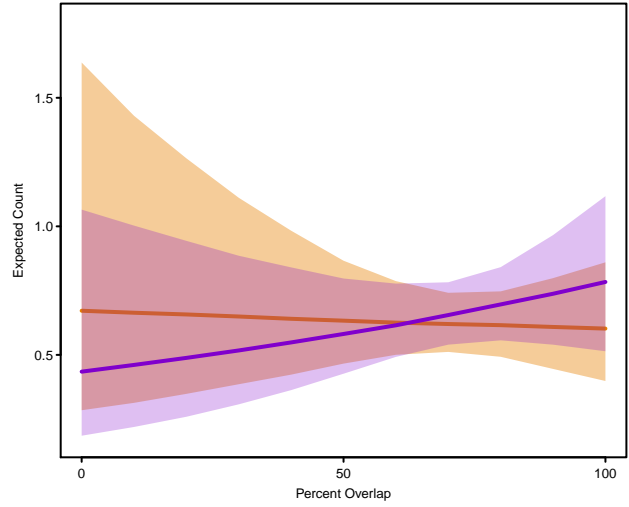
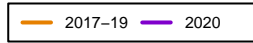


posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

American Crow

Corvus brachyrhynchos



posterior distribution 95% CI
for interaction with
delta_traf includes zero

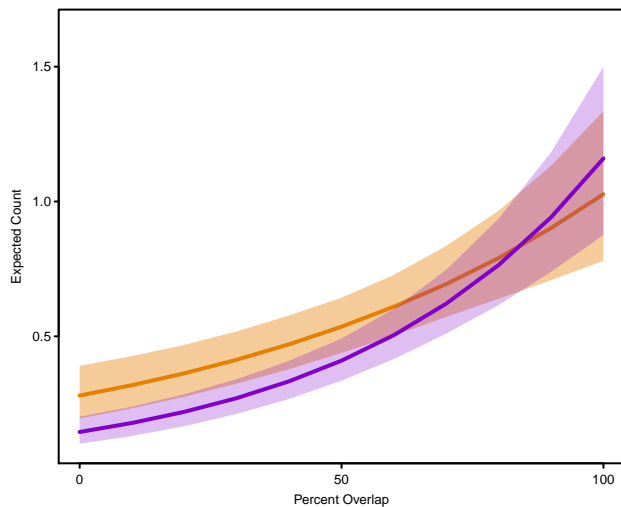
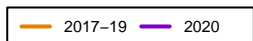
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

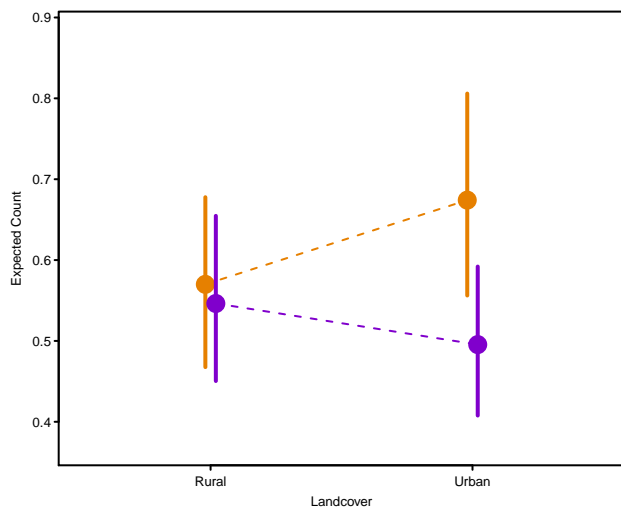
posterior distribution 95% CI
for interaction with
road includes zero

American Goldfinch

Spinus tristis



posterior distribution 95% CI
for interaction with
delta_traf includes zero

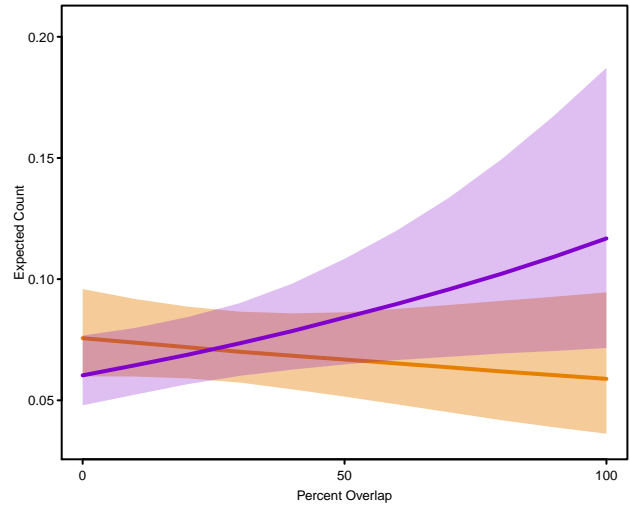
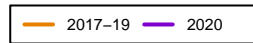


posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

American Redstart

Setophaga ruticilla



posterior distribution 95% CI
for interaction with
delta_traf includes zero

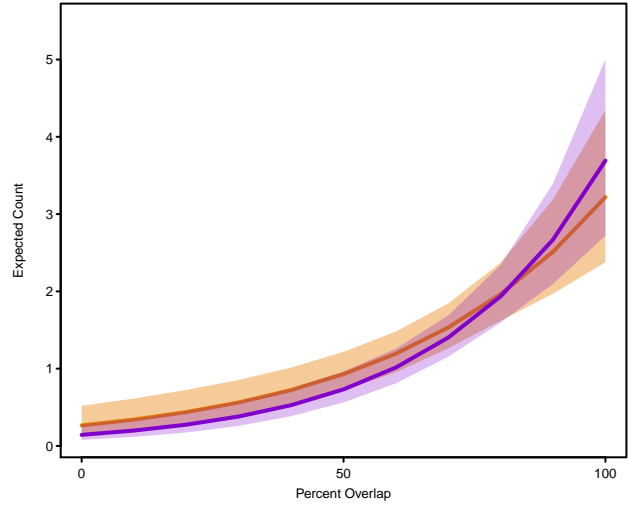
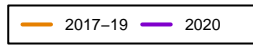
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

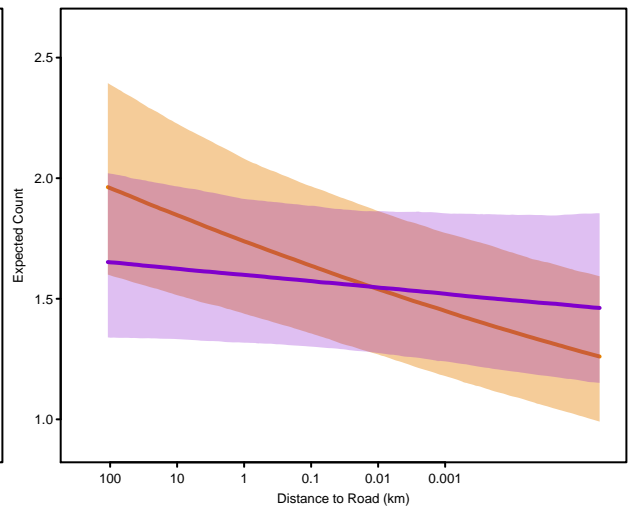
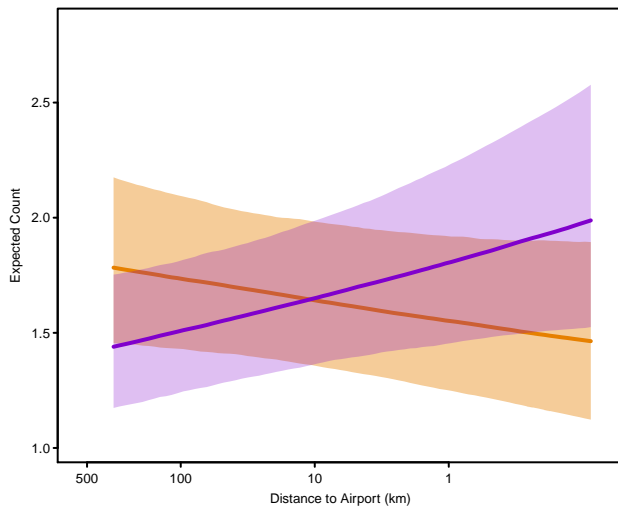
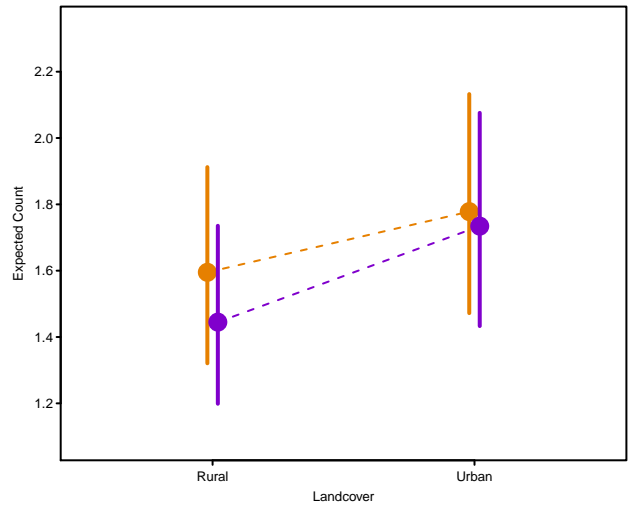
posterior distribution 95% CI
for interaction with
road includes zero

American Robin

Turdus migratorius

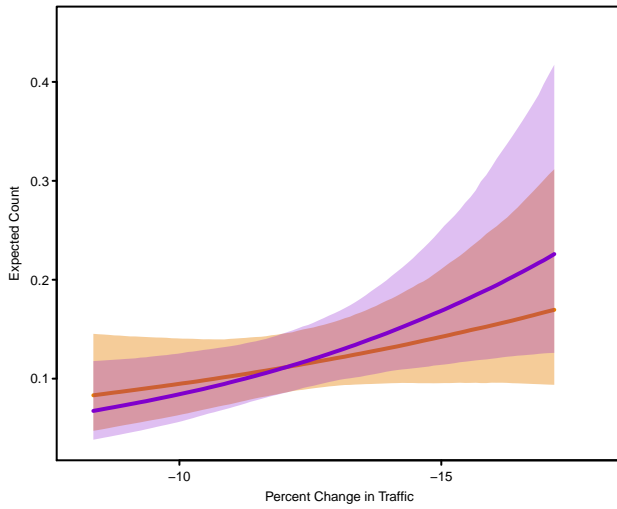
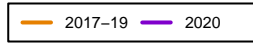


posterior distribution 95% CI
for interaction with
delta_traf includes zero



Bald Eagle

Haliaeetus leucocephalus



posterior distribution 95% CI
for interaction with
overlap includes zero

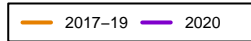
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Baltimore Oriole

Icterus galbula



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

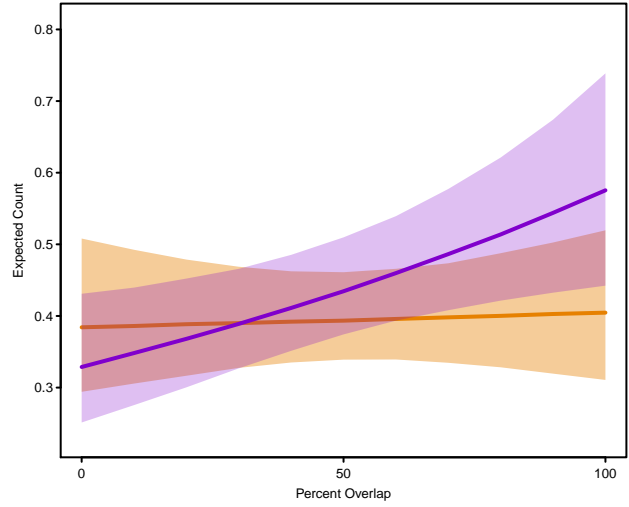
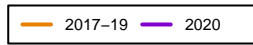
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

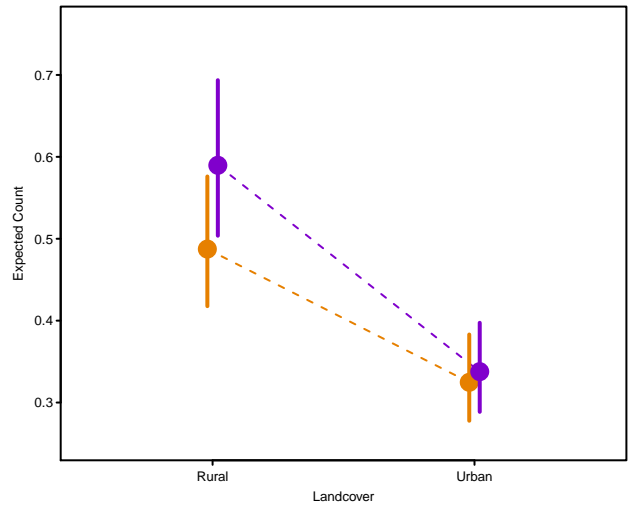
posterior distribution 95% CI
for interaction with
road includes zero

Barn Swallow

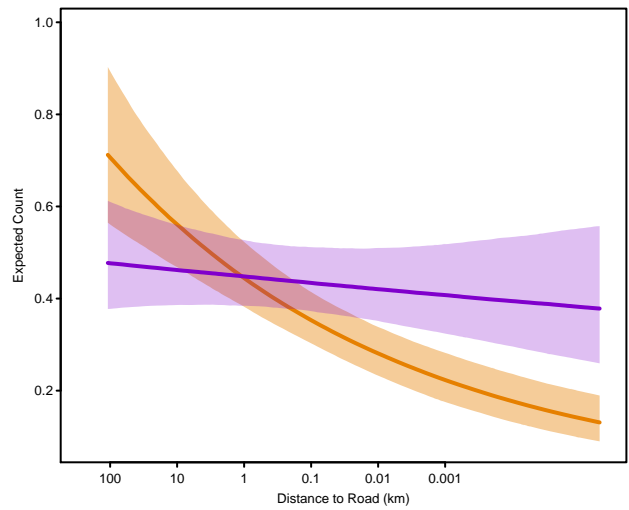
Hirundo rustica



posterior distribution 95% CI
for interaction with
delta_traf includes zero



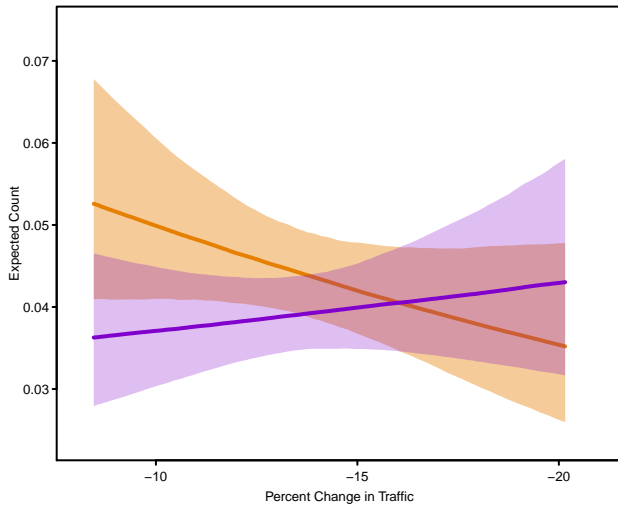
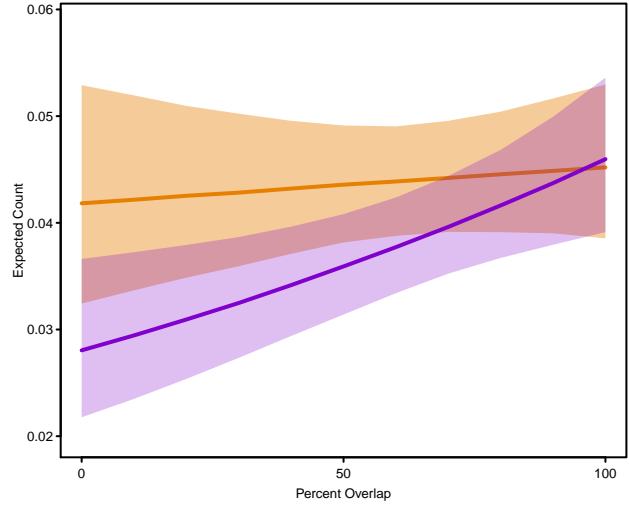
posterior distribution 95% CI
for interaction with
air includes zero



Belted Kingfisher

Megaceryle alcyon

— 2017-19 — 2020



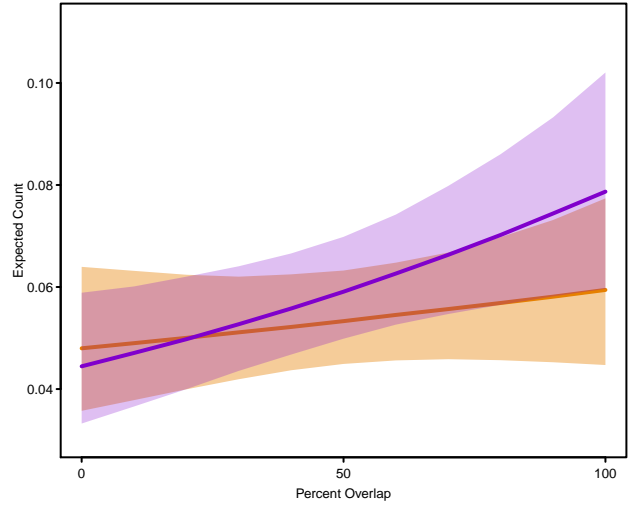
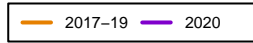
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

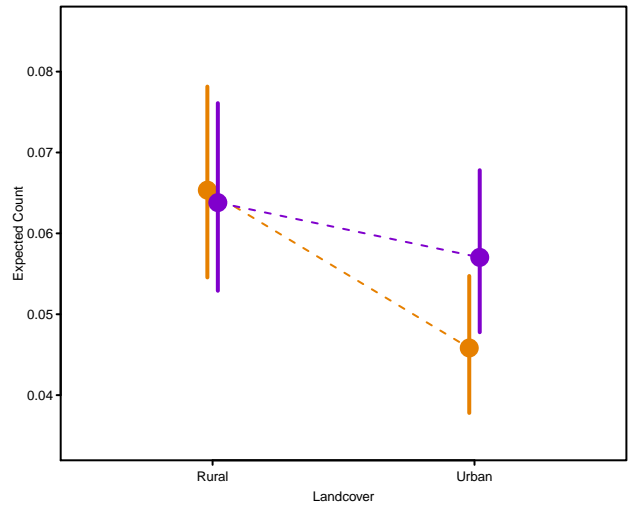
posterior distribution 95% CI
for interaction with
road includes zero

Black-and-white Warbler

Mniotilta varia



posterior distribution 95% CI
for interaction with
delta_traf includes zero



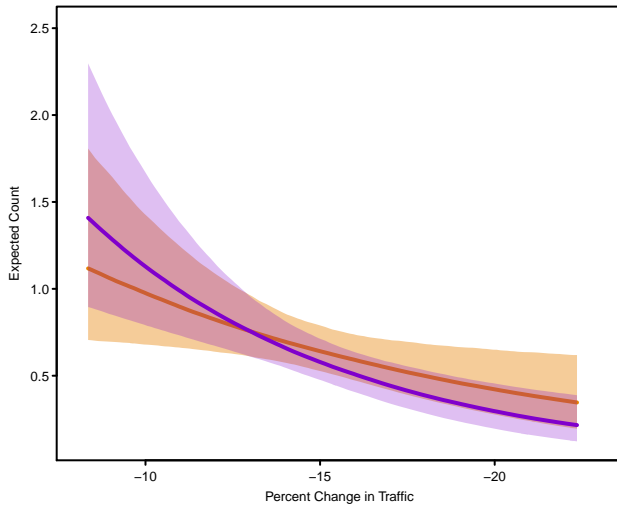
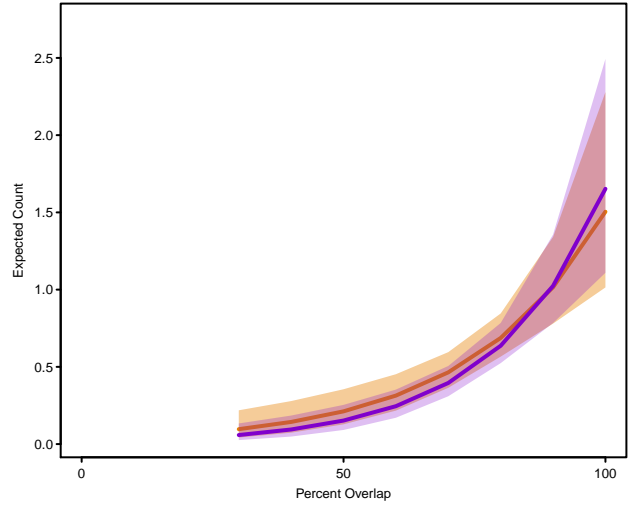
posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Black-capped Chickadee

Poecile atricapillus

2017-19 2020



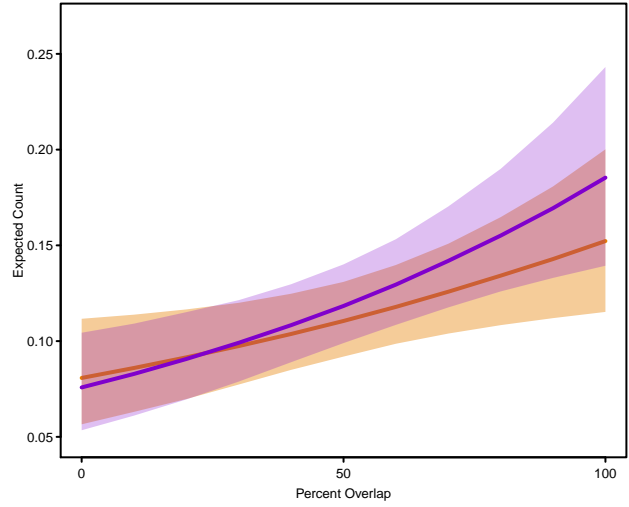
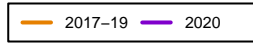
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

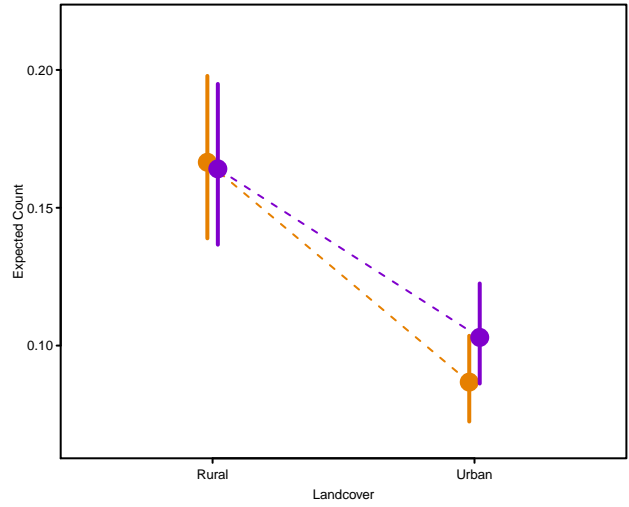
posterior distribution 95% CI
for interaction with
road includes zero

Blue-gray Gnatcatcher

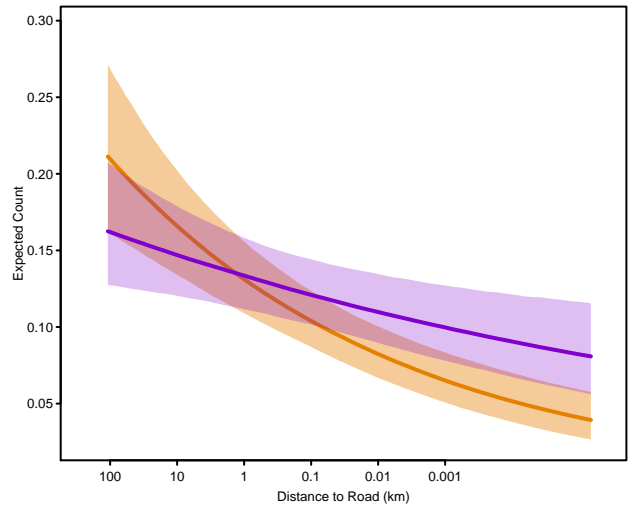
Polioptila caerulea



posterior distribution 95% CI
for interaction with
delta_traf includes zero

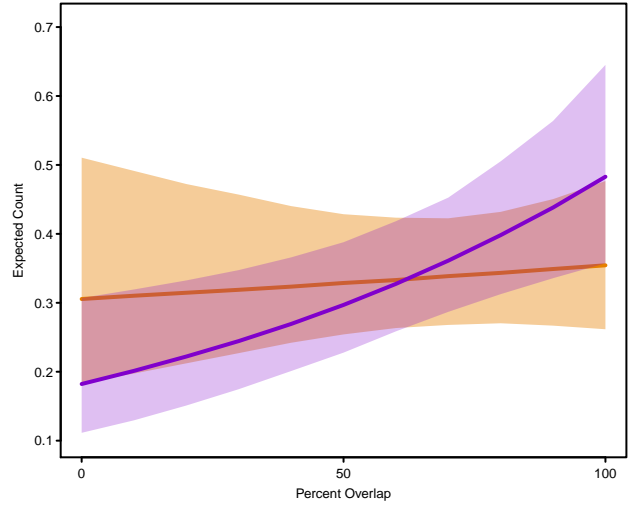
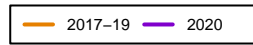


posterior distribution 95% CI
for interaction with
air includes zero



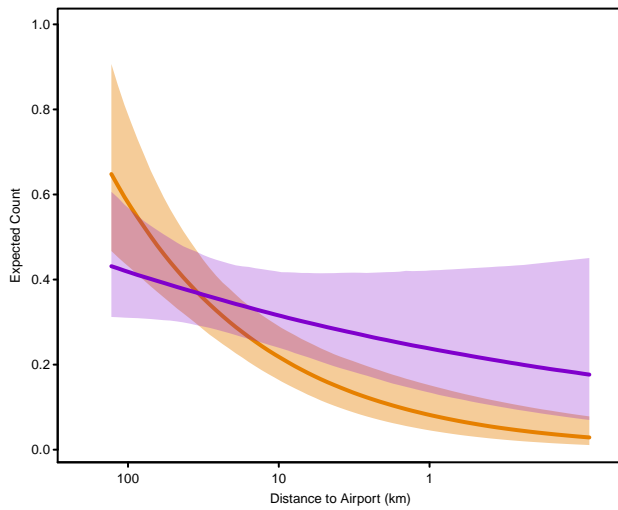
Blue-winged Teal

Spatula discors



posterior distribution 95% CI
for interaction with
delta_traf includes zero

posterior distribution 95% CI
for interaction with
land includes zero

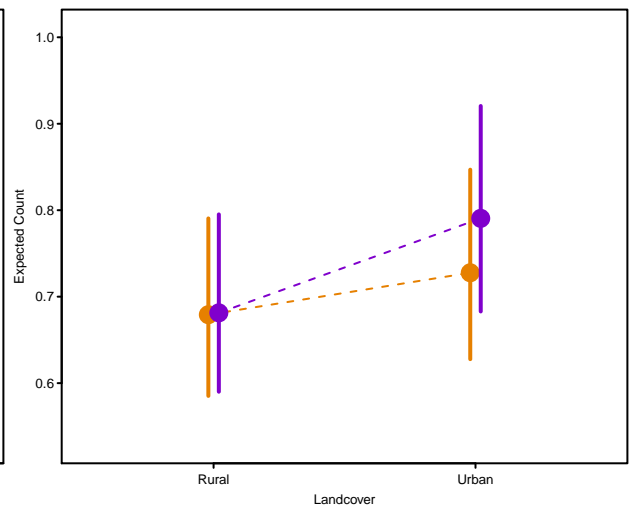
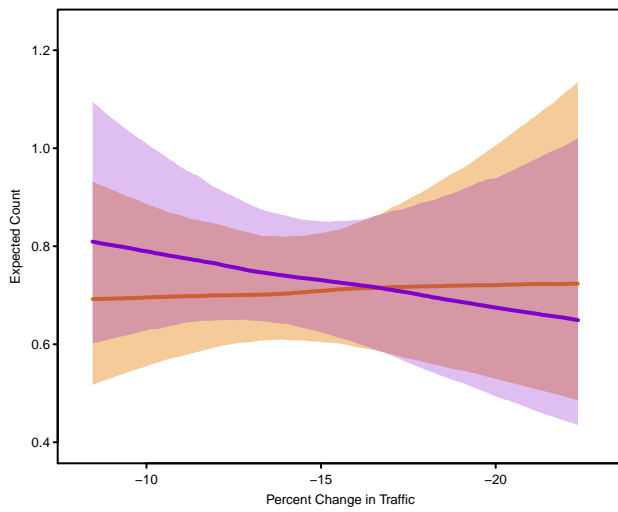
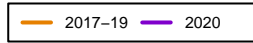


posterior distribution 95% CI
for interaction with
road includes zero

Blue Jay

Cyanocitta cristata

posterior distribution 95% CI
for interaction with
overlap includes zero



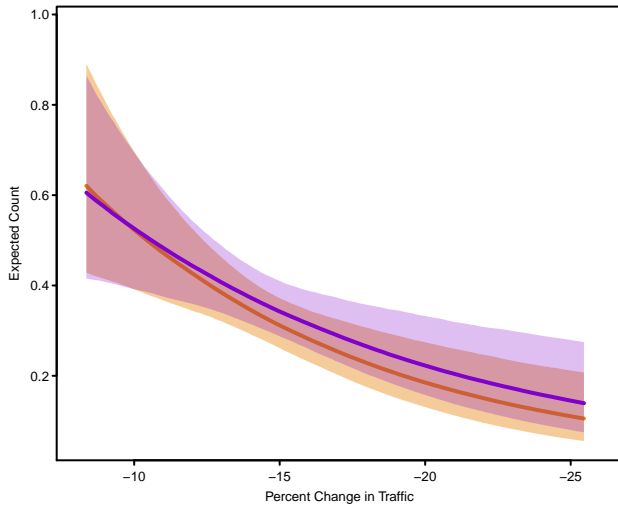
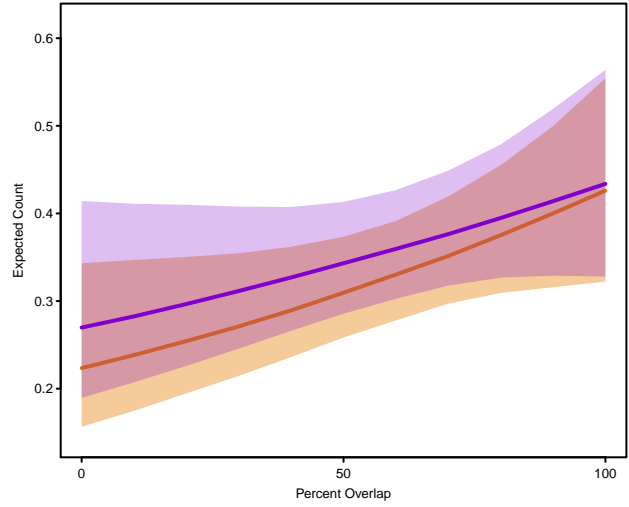
posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Brown-headed Cowbird

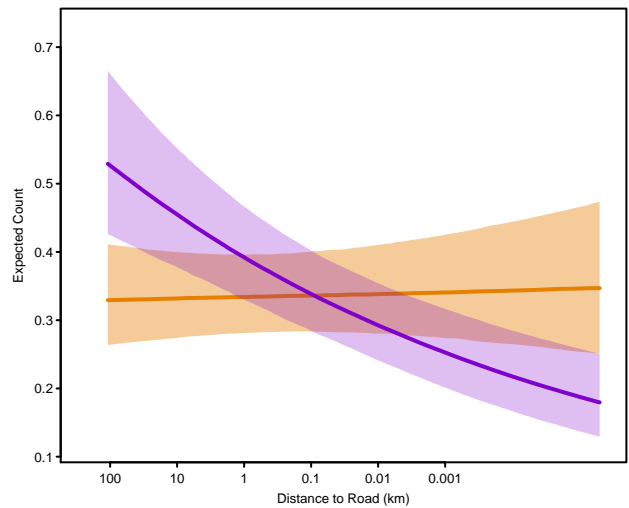
Molothrus ater

2017-19 2020



posterior distribution 95% CI
for interaction with
land includes zero

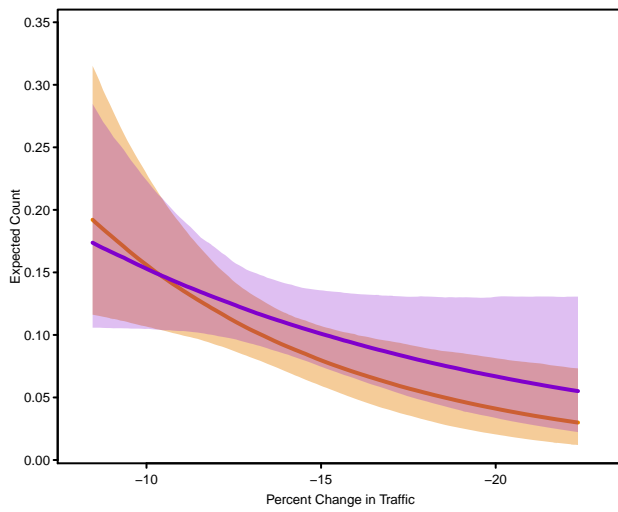
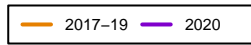
posterior distribution 95% CI
for interaction with
air includes zero



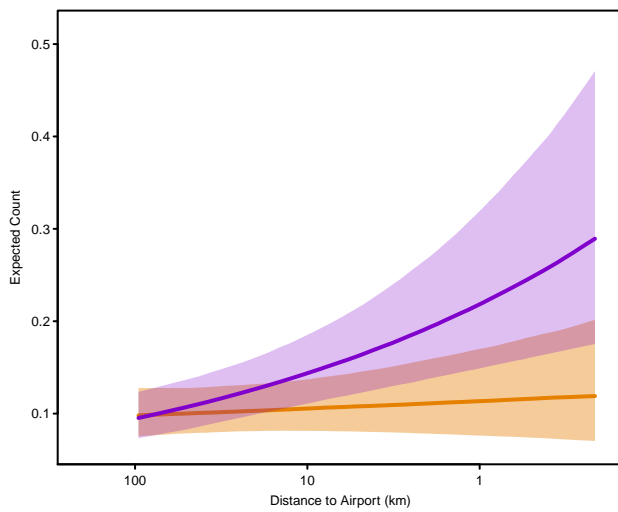
Brown Thrasher

Toxostoma rufum

posterior distribution 95% CI
for interaction with
overlap includes zero



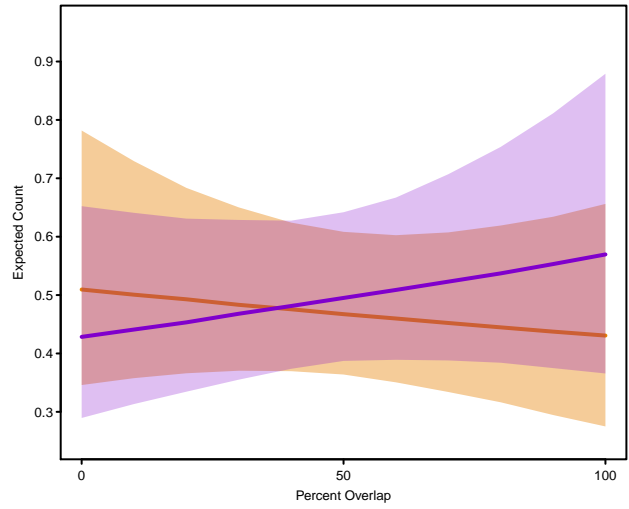
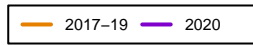
posterior distribution 95% CI
for interaction with
land includes zero



posterior distribution 95% CI
for interaction with
road includes zero

Bufflehead

Bucephala albeola



posterior distribution 95% CI
for interaction with
delta_traf includes zero

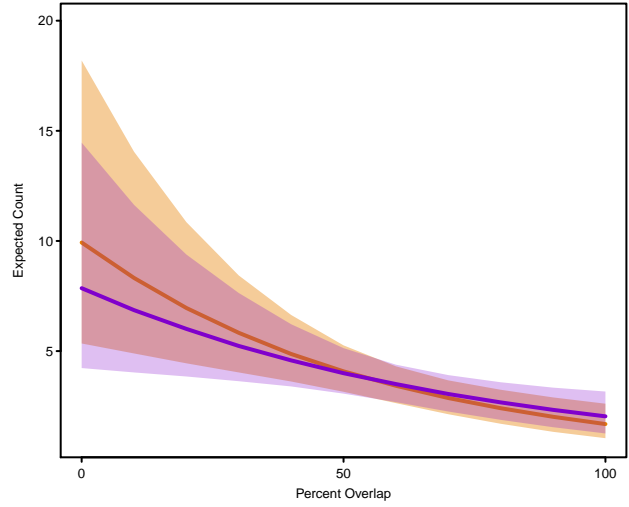
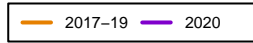
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

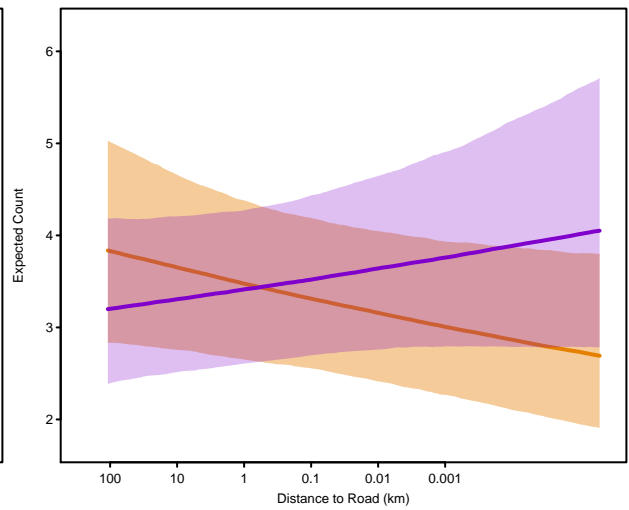
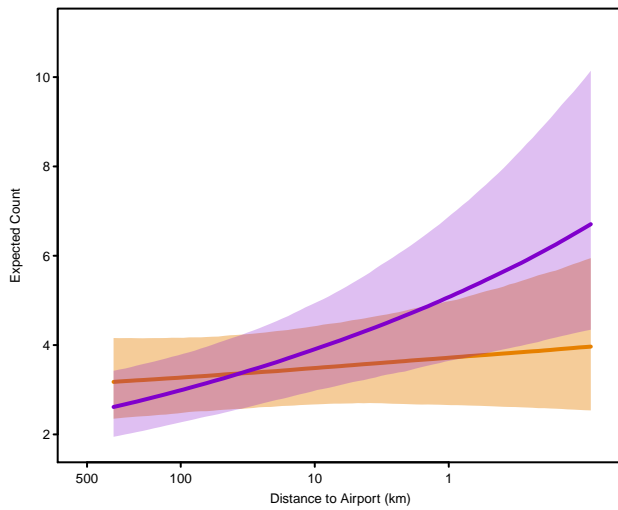
Canada Goose

Branta canadensis



posterior distribution 95% CI
for interaction with
delta_traf includes zero

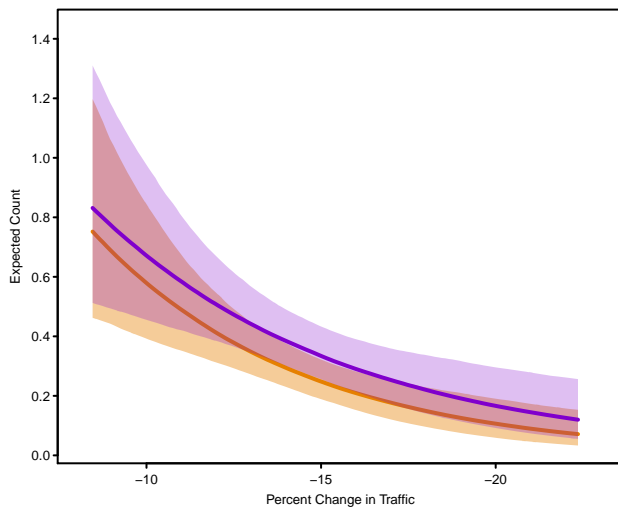
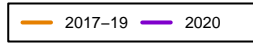
posterior distribution 95% CI
for interaction with
land includes zero



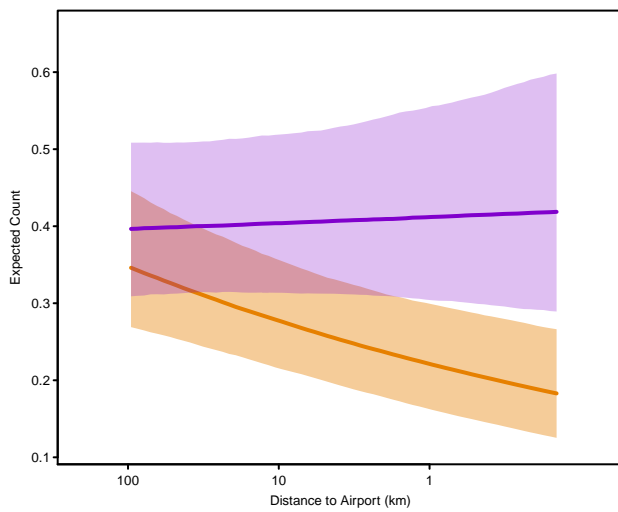
Carolina Wren

Thryothorus ludovicianus

posterior distribution 95% CI
for interaction with
overlap includes zero



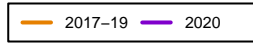
posterior distribution 95% CI
for interaction with
land includes zero



posterior distribution 95% CI
for interaction with
road includes zero

Cedar Waxwing

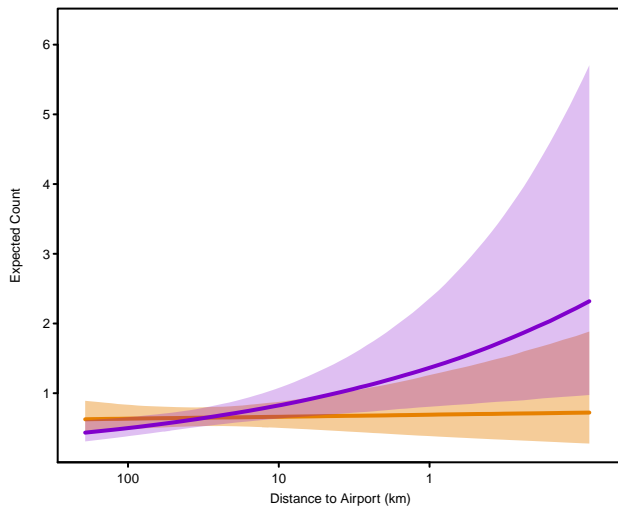
Bombycilla cedrorum



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

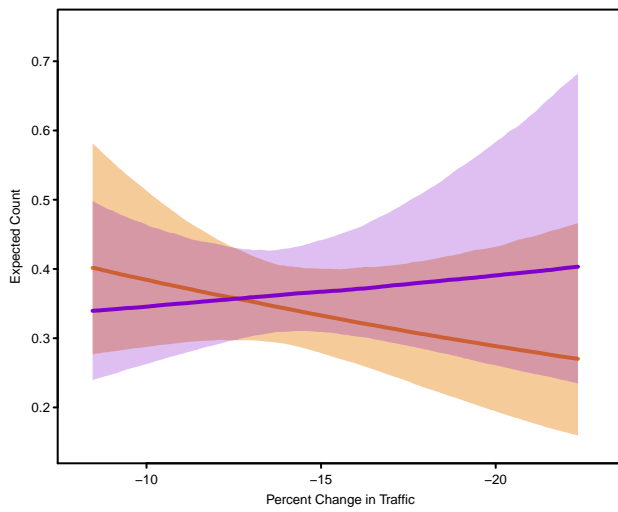
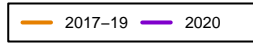
posterior distribution 95% CI
for interaction with
land includes zero



posterior distribution 95% CI
for interaction with
road includes zero

Chimney Swift

Chaetura pelagica



posterior distribution 95% CI
for interaction with
overlap includes zero

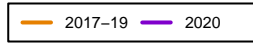
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Chipping Sparrow

Spizella passerina

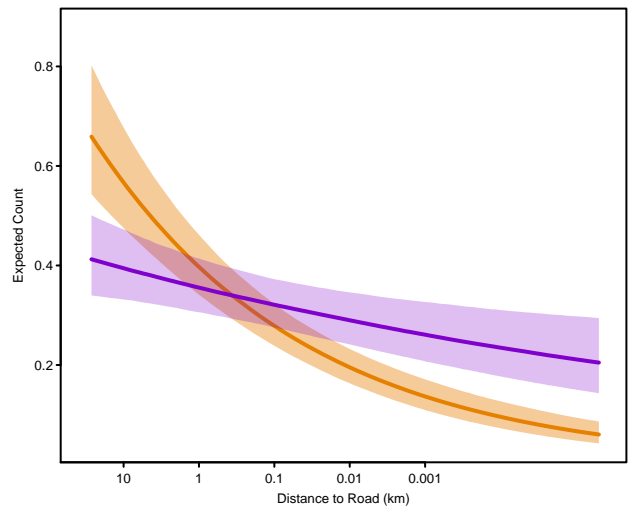


posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

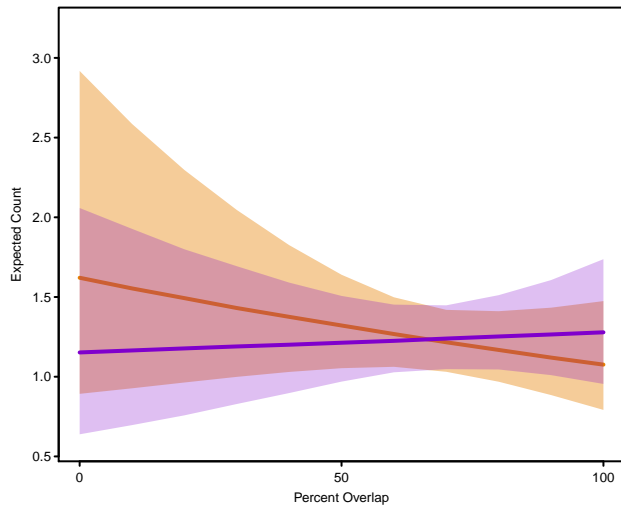
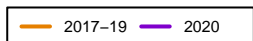
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

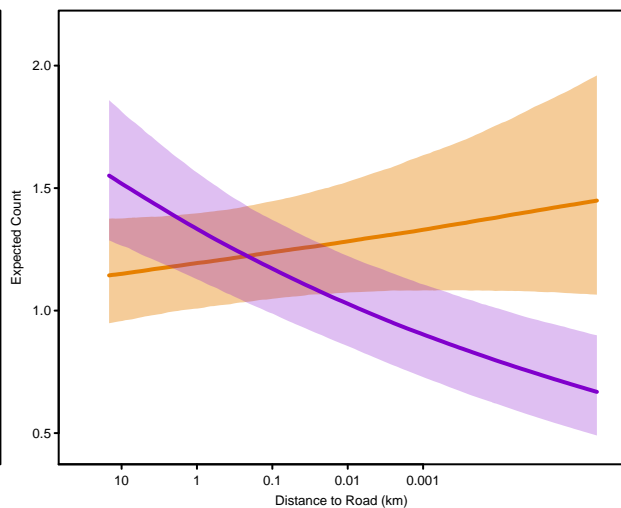
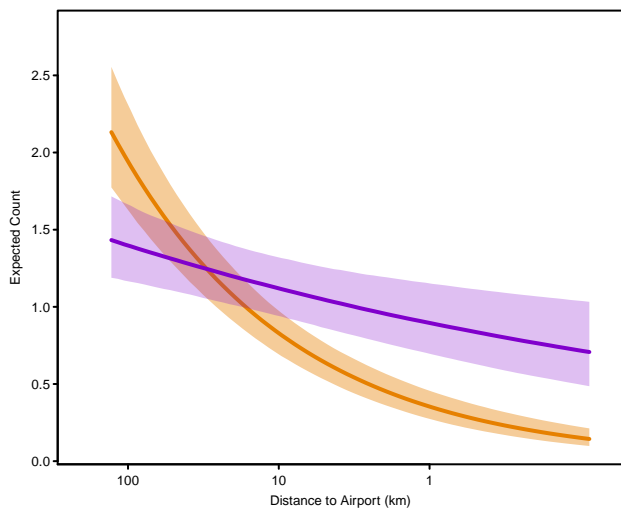
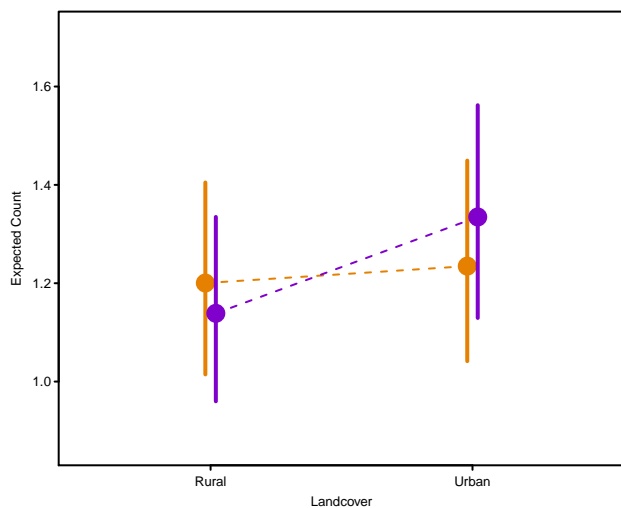


Common Grackle

Quiscalus quiscula

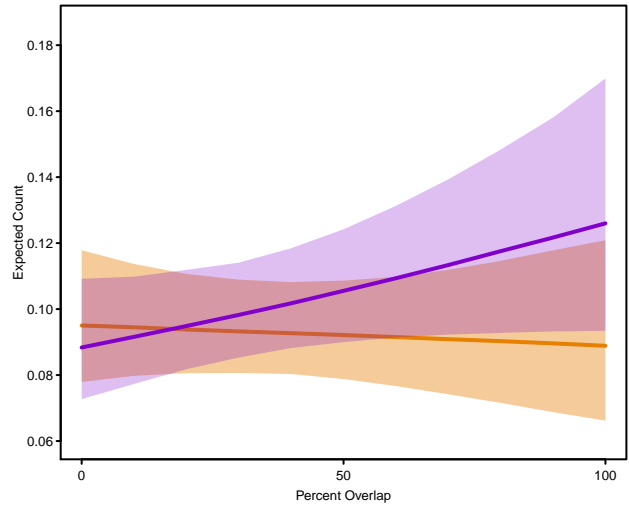
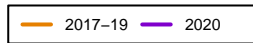


posterior distribution 95% CI
for interaction with
delta_traf includes zero



Common Yellowthroat

Geothlypis trichas



posterior distribution 95% CI
for interaction with
delta_traf includes zero

posterior distribution 95% CI
for interaction with
land includes zero

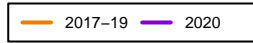
posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Cooper's Hawk

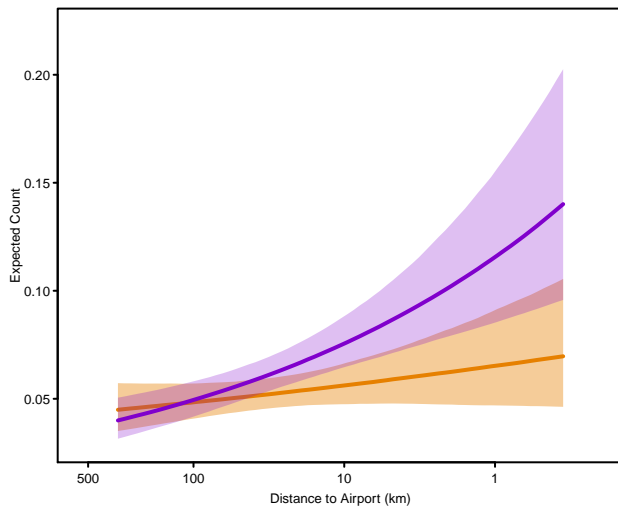
Accipiter cooperii

posterior distribution 95% CI
for interaction with
overlap includes zero



posterior distribution 95% CI
for interaction with
delta_traf includes zero

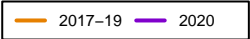
posterior distribution 95% CI
for interaction with
land includes zero



posterior distribution 95% CI
for interaction with
road includes zero

Dark-eyed Junco

Junco hyemalis



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

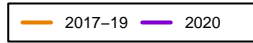
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

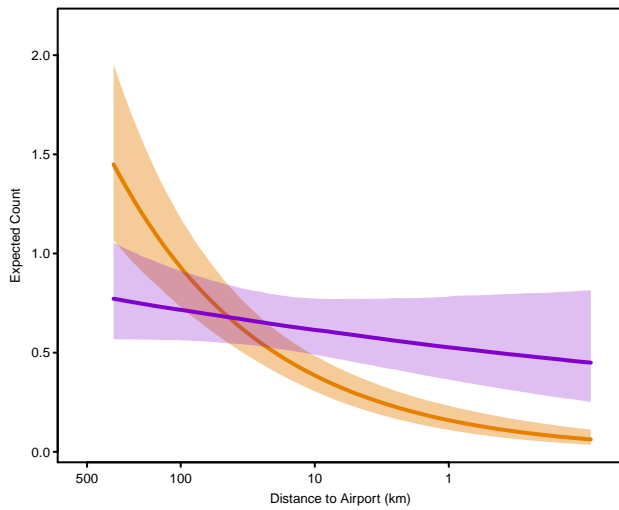
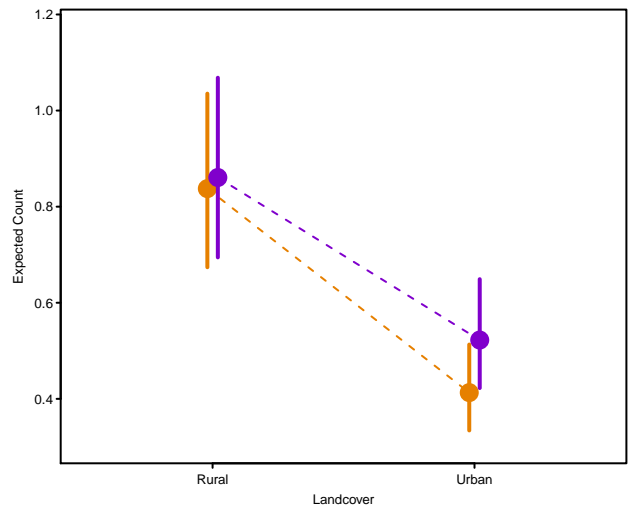
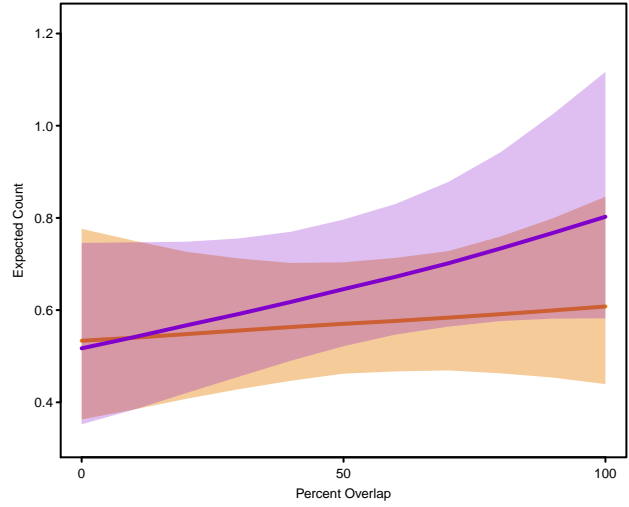
posterior distribution 95% CI
for interaction with
road includes zero

Double-crested Cormorant

Phalacrocorax auritus



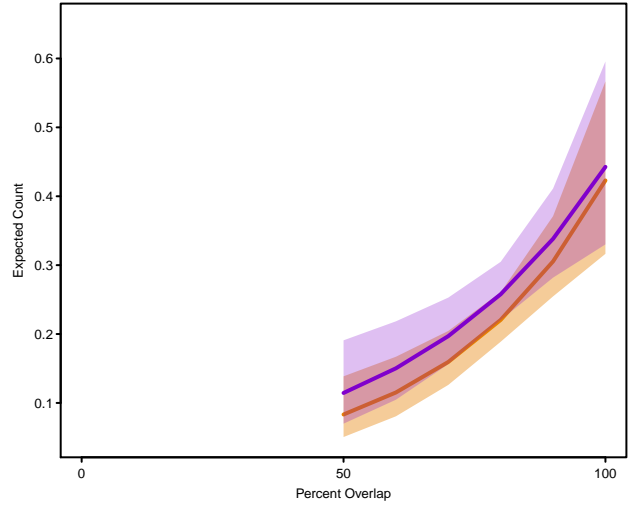
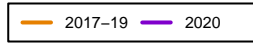
posterior distribution 95% CI
for interaction with
delta_traf includes zero



posterior distribution 95% CI
for interaction with
road includes zero

Downy Woodpecker

Dryobates pubescens



posterior distribution 95% CI
for interaction with
delta_traf includes zero

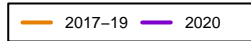
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Eastern Bluebird

Sialia sialis



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

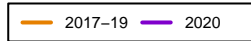
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Eastern Kingbird

Tyrannus tyrannus



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

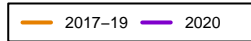
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Eastern Phoebe

Sayornis phoebe

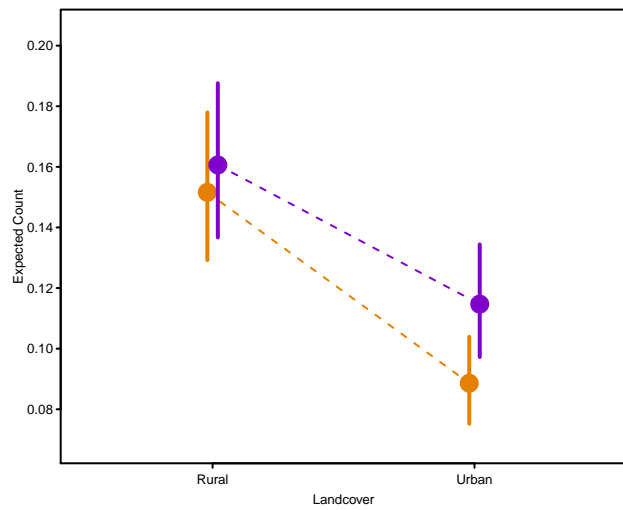


posterior distribution 95% CI
for interaction with
delta_traf includes zero

posterior distribution 95% CI
for interaction with
air includes zero

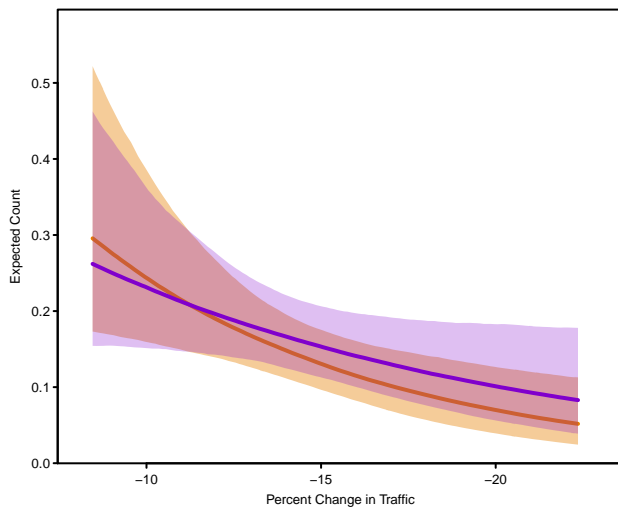
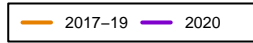
posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
road includes zero



Eastern Towhee

Pipilo erythrophthalmus



posterior distribution 95% CI
for interaction with
overlap includes zero

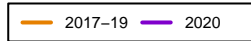
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Eurasian Collared-Dove

Streptopelia decaocto



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

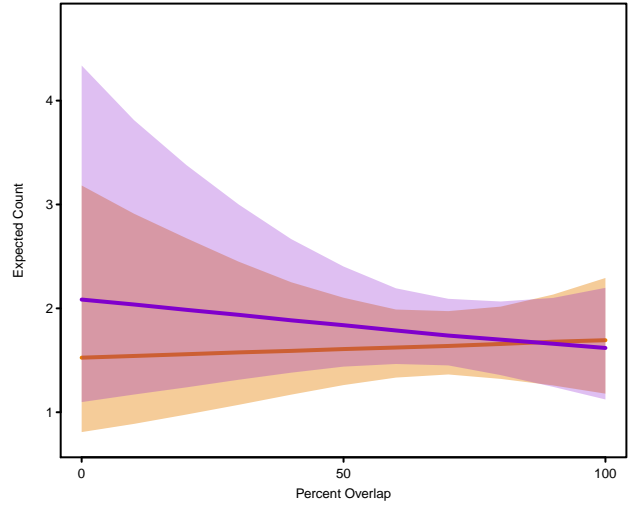
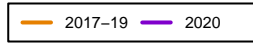
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

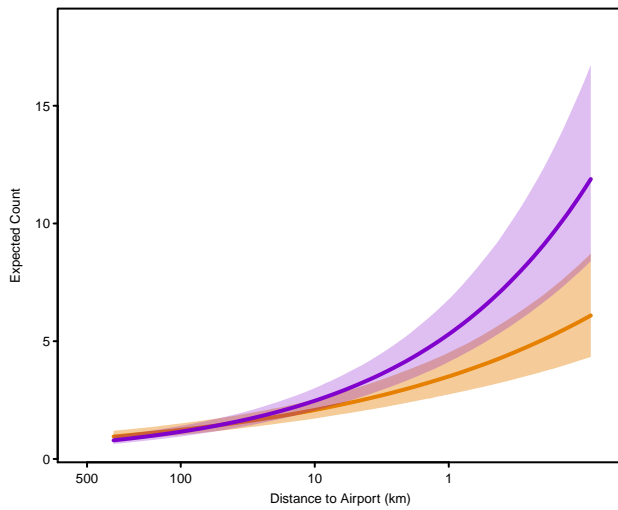
European Starling

Sturnus vulgaris



posterior distribution 95% CI
for interaction with
delta_traf includes zero

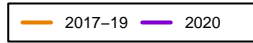
posterior distribution 95% CI
for interaction with
land includes zero



posterior distribution 95% CI
for interaction with
road includes zero

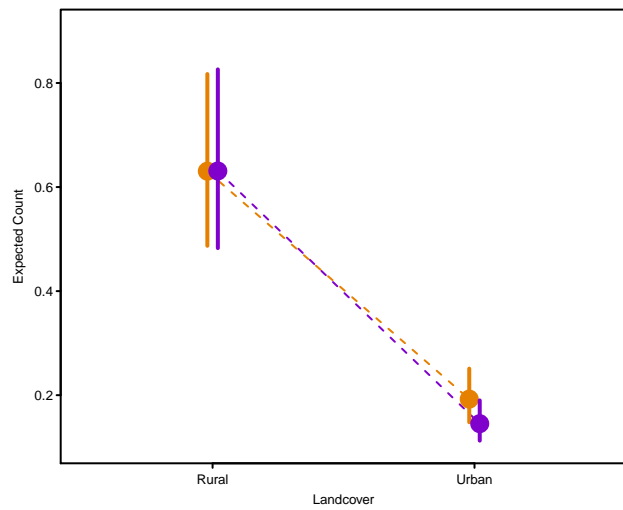
Gadwall

Mareca strepera



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

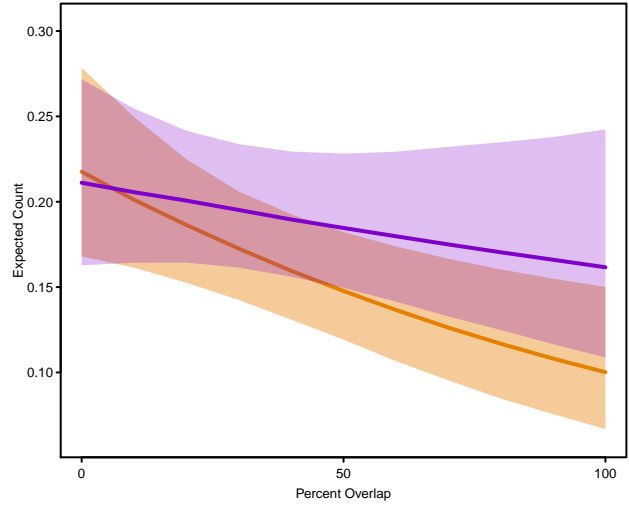
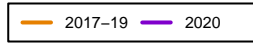


posterior distribution 95% CI
for interaction with
air includes zero

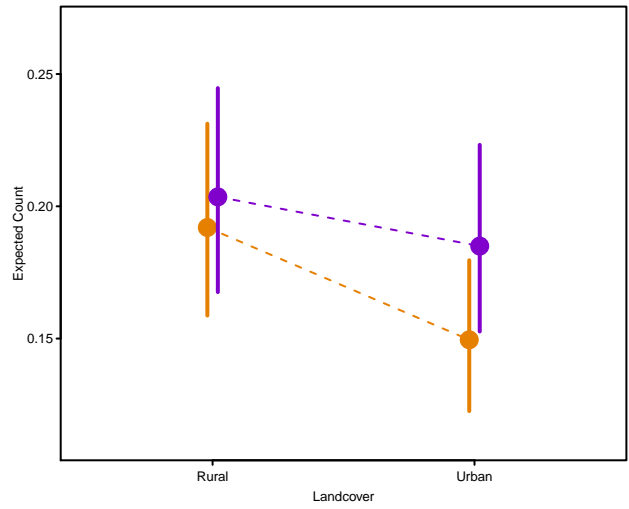
posterior distribution 95% CI
for interaction with
road includes zero

Gray Catbird

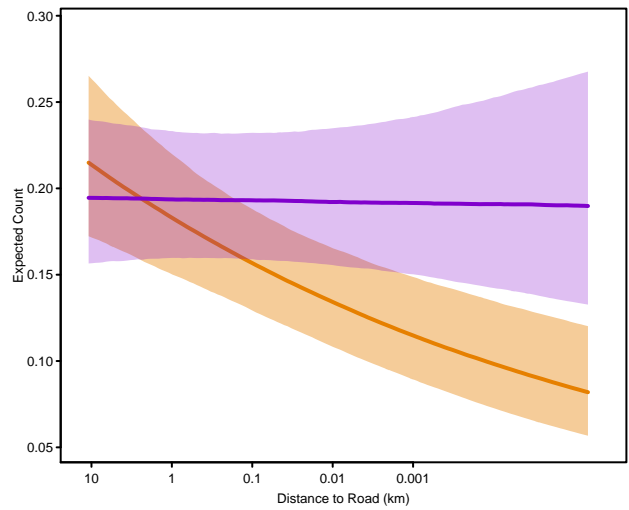
Dumetella carolinensis



posterior distribution 95% CI
for interaction with
delta_traf includes zero

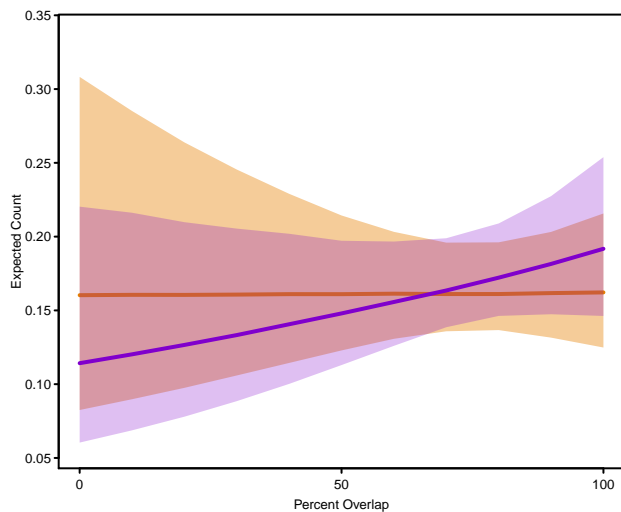
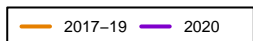


posterior distribution 95% CI
for interaction with
air includes zero



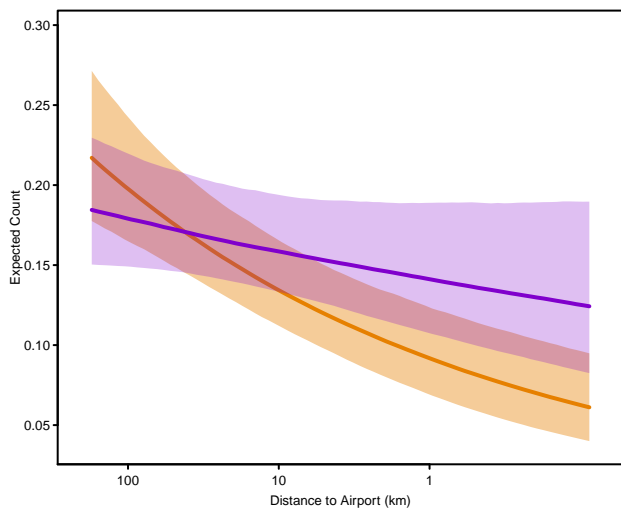
Great Blue Heron

Ardea herodias



posterior distribution 95% CI
for interaction with
delta_traf includes zero

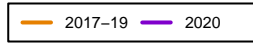
posterior distribution 95% CI
for interaction with
land includes zero



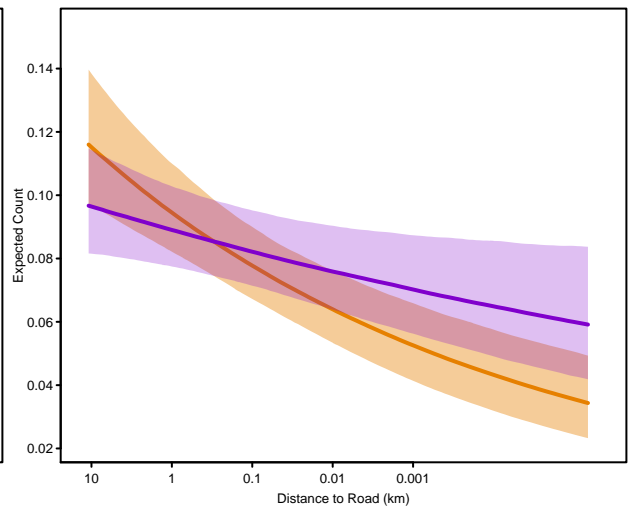
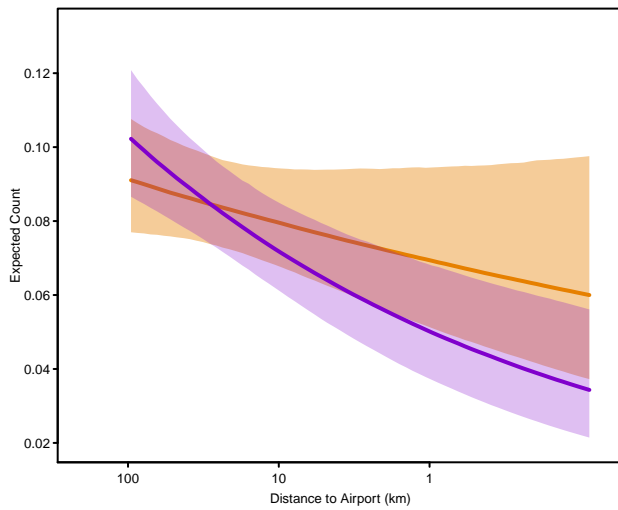
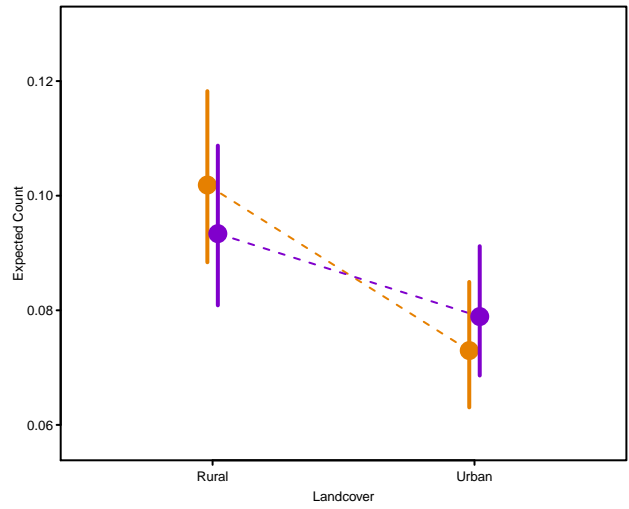
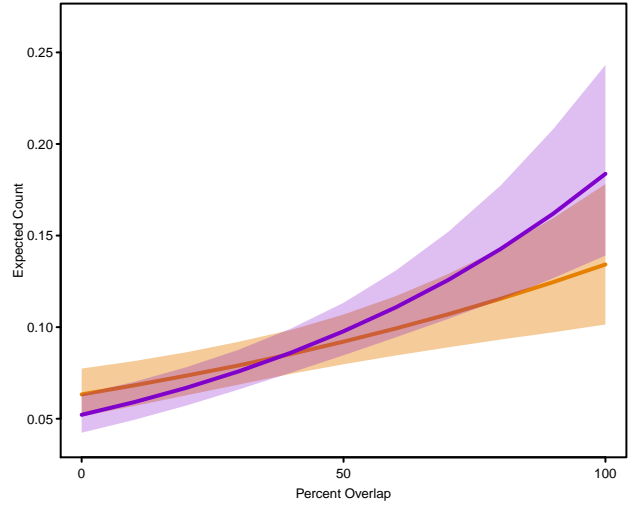
posterior distribution 95% CI
for interaction with
road includes zero

Great Crested Flycatcher

Myiarchus crinitus

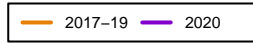


posterior distribution 95% CI
for interaction with
delta_traf includes zero



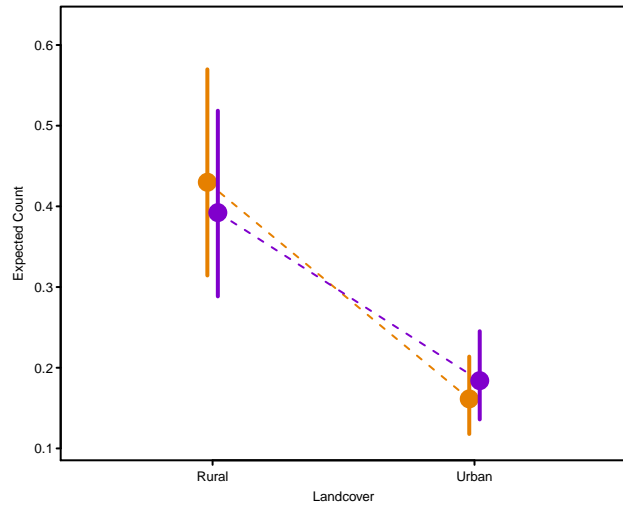
Great Egret

Ardea alba



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

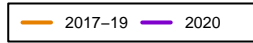


posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Hairy Woodpecker

Dryobates villosus



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

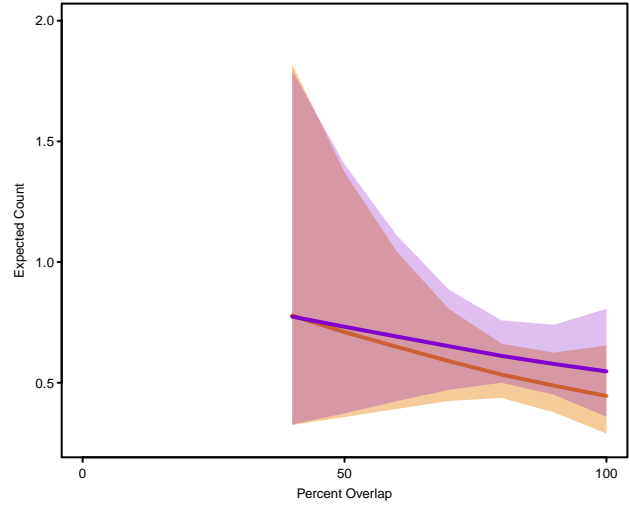
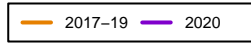
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

House Finch

Haemorhous mexicanus



posterior distribution 95% CI
for interaction with
delta_traf includes zero

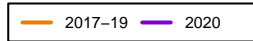
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

House Sparrow

Passer domesticus



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

posterior distribution 95% CI
for interaction with
land includes zero

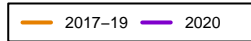
posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

House Wren

Troglodytes aedon

posterior distribution 95% CI
for interaction with
overlap includes zero



posterior distribution 95% CI
for interaction with
delta_traf includes zero

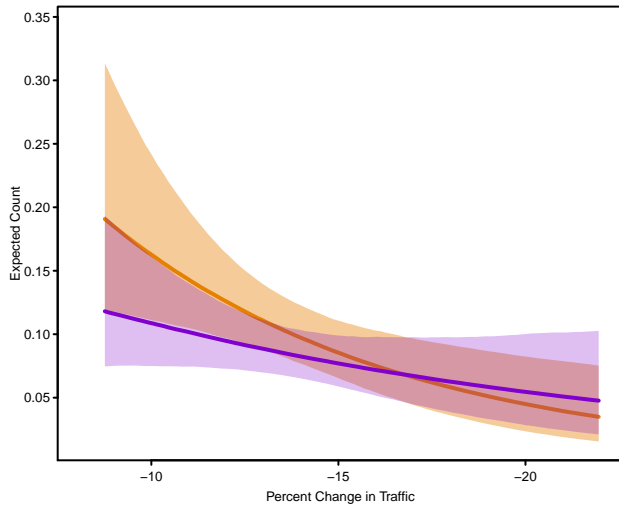
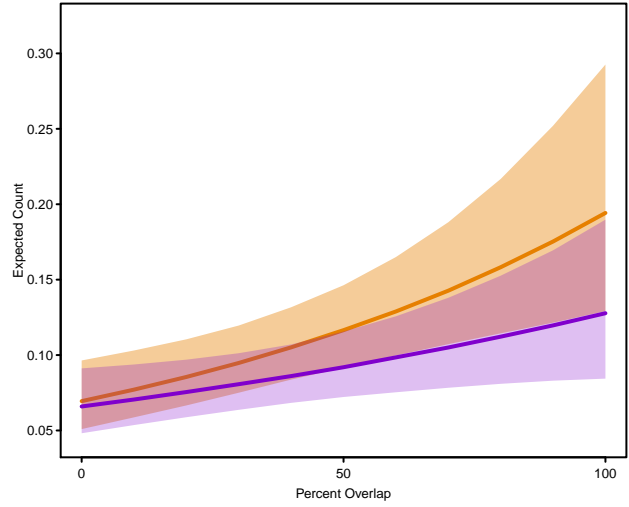
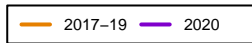
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

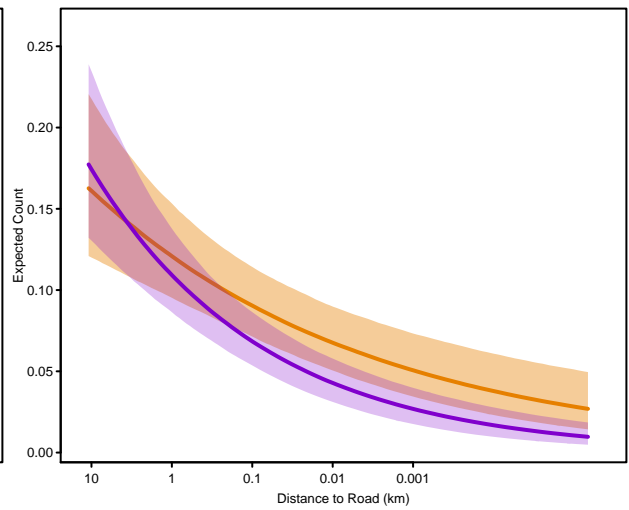
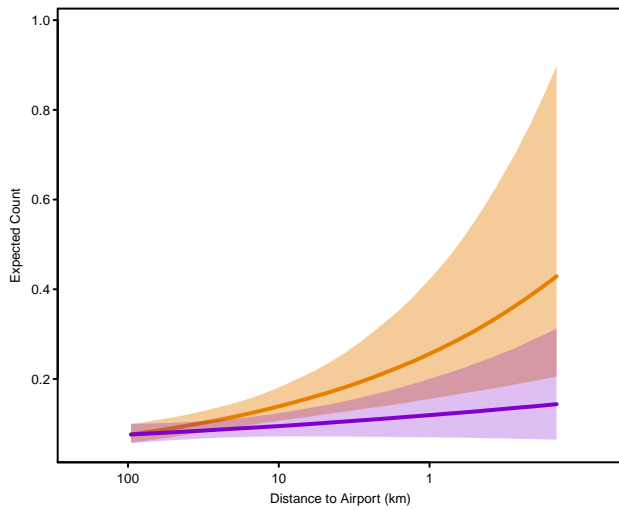
posterior distribution 95% CI
for interaction with
road includes zero

Indigo Bunting

Passerina cyanea

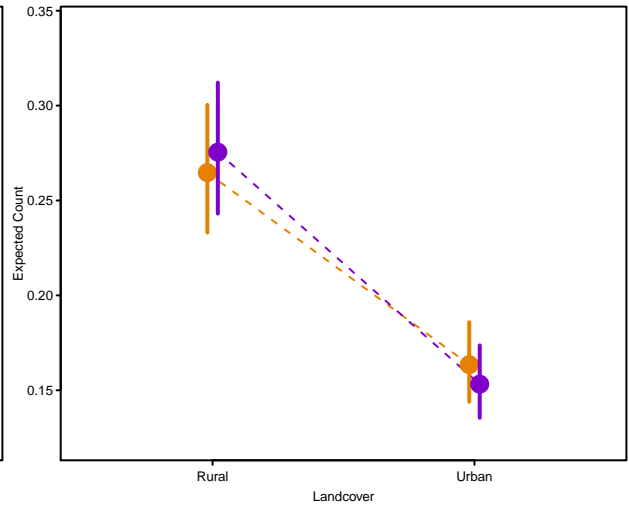
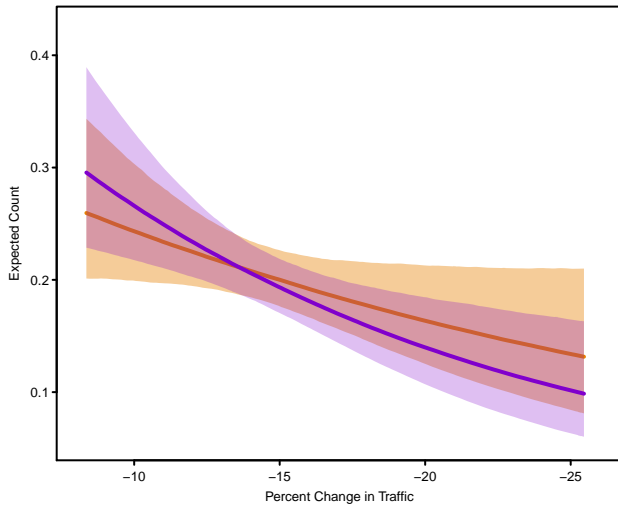
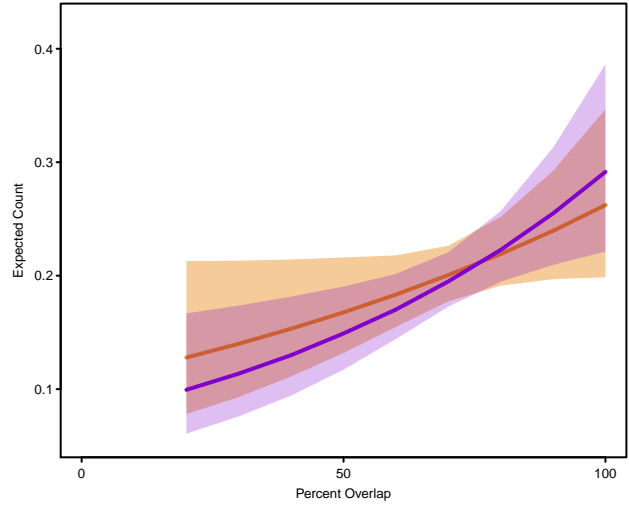
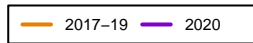


posterior distribution 95% CI
for interaction with
land includes zero

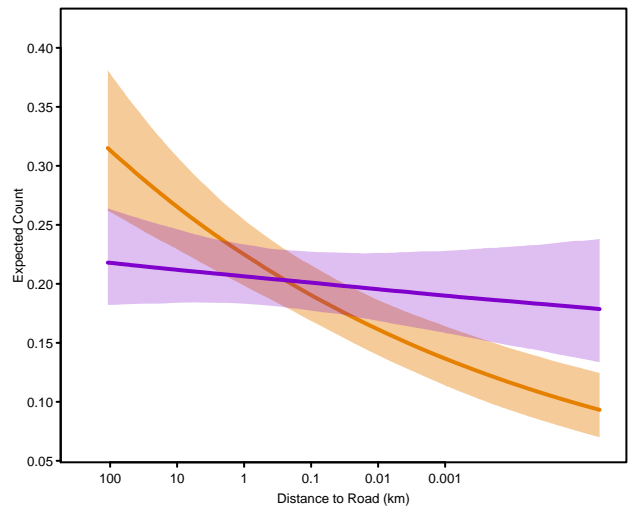


Killdeer

Charadrius vociferus

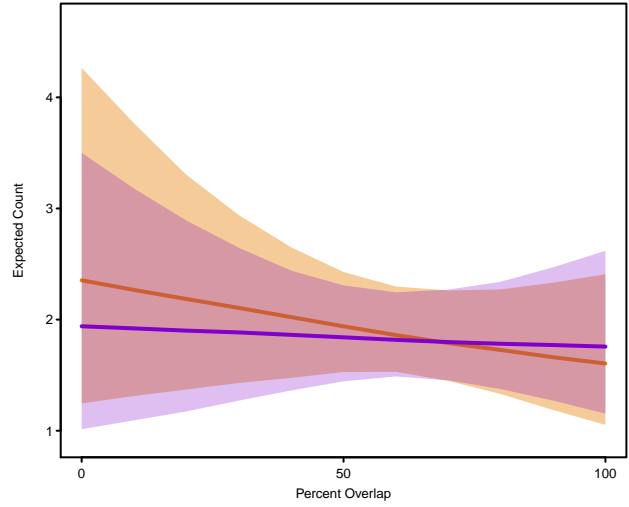
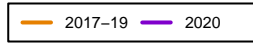


posterior distribution 95% CI
for interaction with
air includes zero

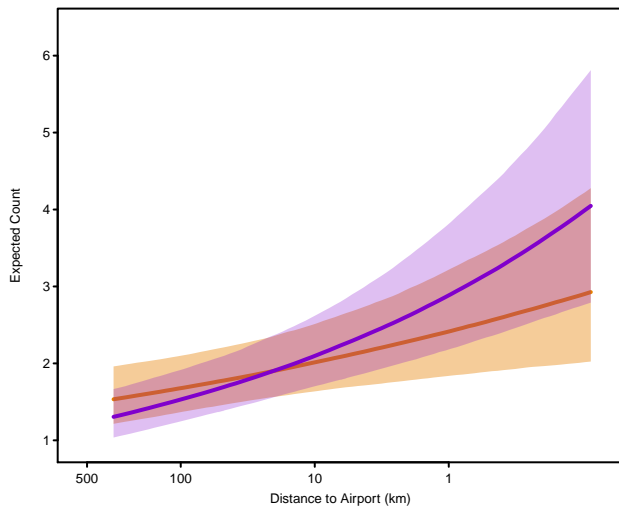
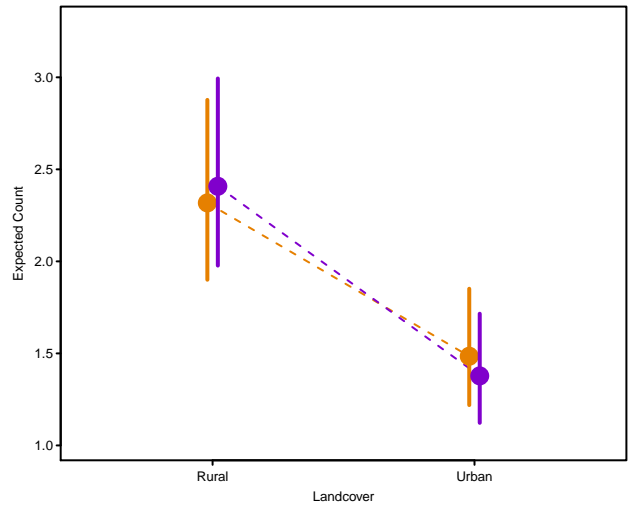


Mallard

Anas platyrhynchos



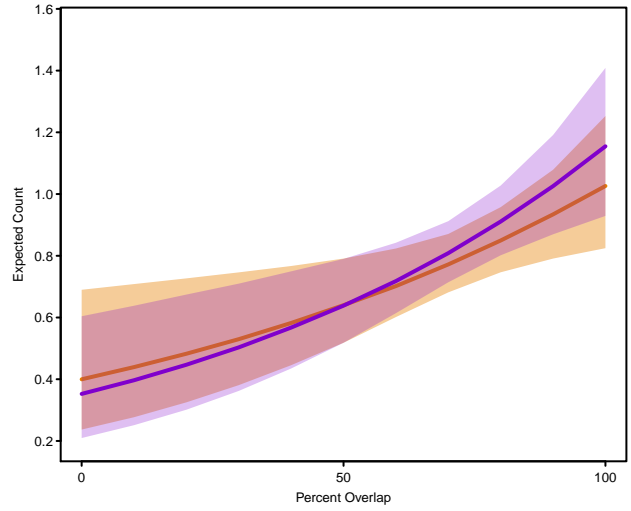
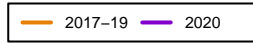
posterior distribution 95% CI
for interaction with
delta_traf includes zero



posterior distribution 95% CI
for interaction with
road includes zero

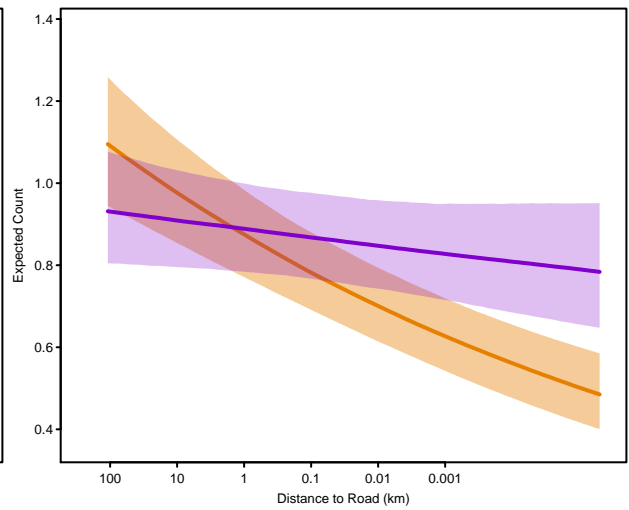
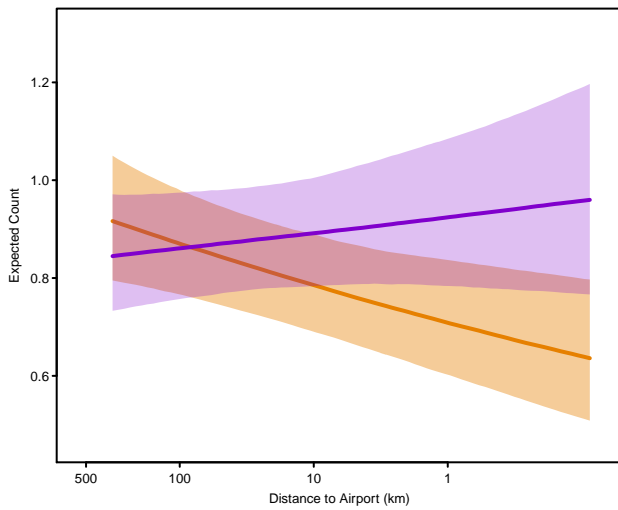
Mourning Dove

Zenaida macroura



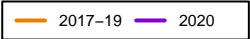
posterior distribution 95% CI
for interaction with
delta_traf includes zero

posterior distribution 95% CI
for interaction with
land includes zero



Nashville Warbler

Leiothlypis ruficapilla



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

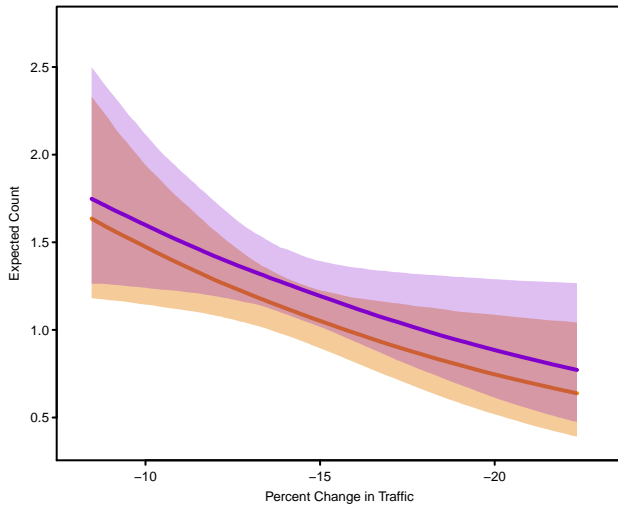
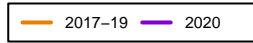
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Northern Cardinal

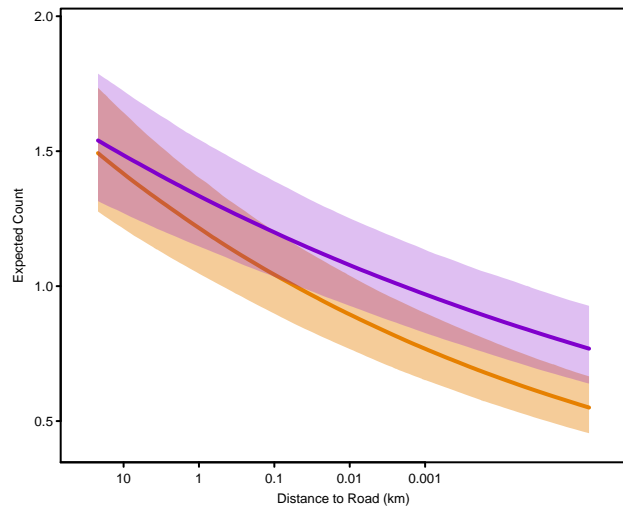
Cardinalis cardinalis



posterior distribution 95% CI
for interaction with
overlap includes zero

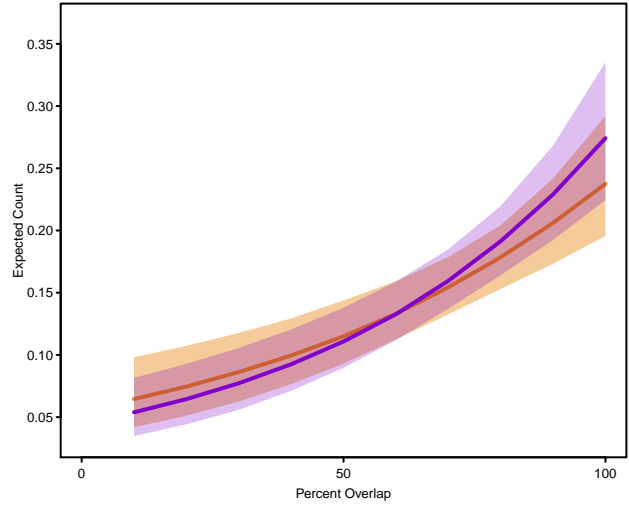
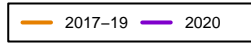
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

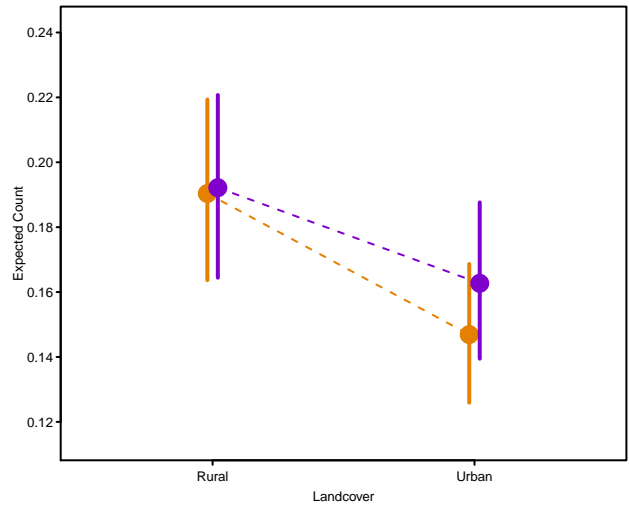


Northern Flicker

Colaptes auratus



posterior distribution 95% CI
for interaction with
delta_traf includes zero

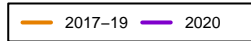


posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Northern Mockingbird

Mimus polyglottos



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

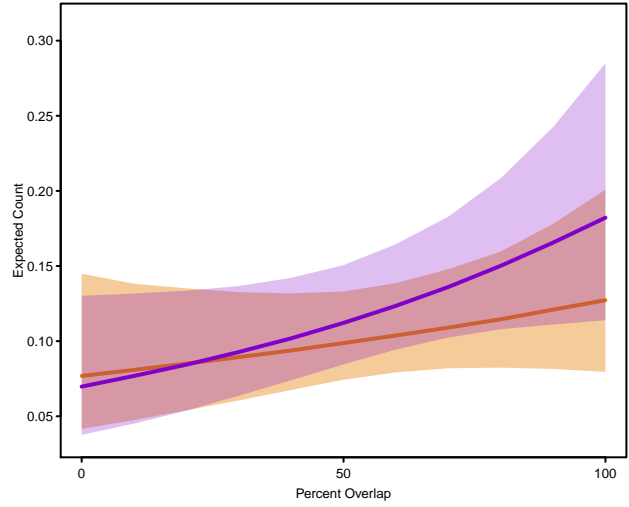
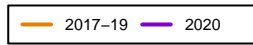
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

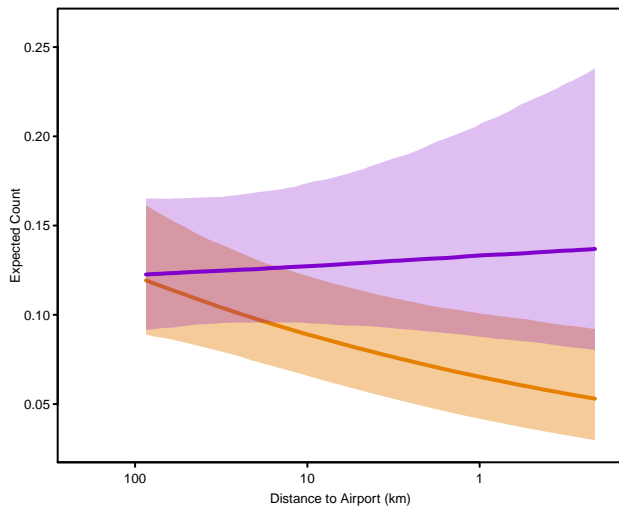
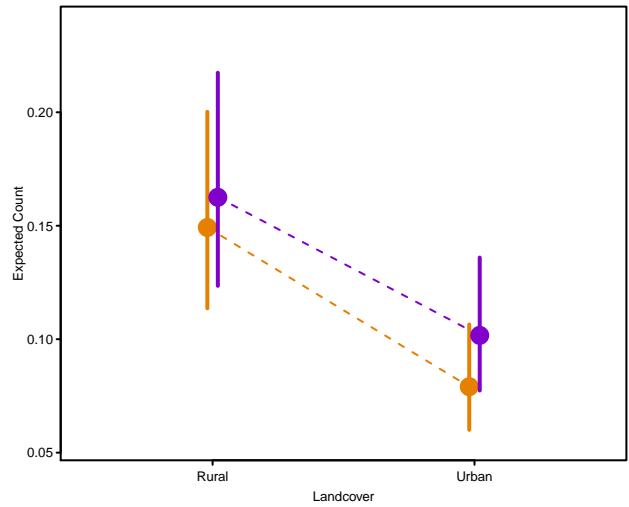
posterior distribution 95% CI
for interaction with
road includes zero

Northern Parula

Setophaga americana



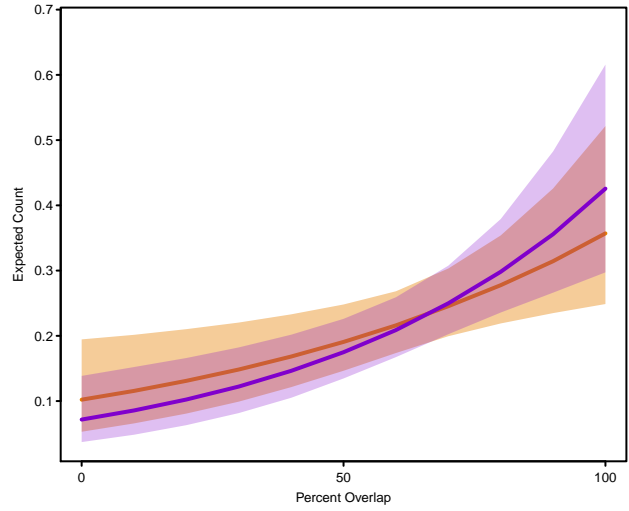
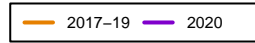
posterior distribution 95% CI
for interaction with
delta_traf includes zero



posterior distribution 95% CI
for interaction with
road includes zero

Northern Rough-winged Swallow

Stelgidopteryx serripennis



posterior distribution 95% CI
for interaction with
delta_traf includes zero

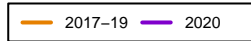
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Orange-crowned Warbler

Leiothlypis celata



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

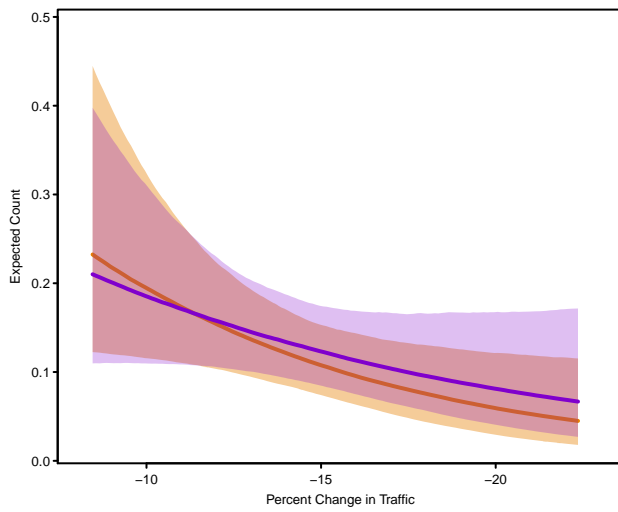
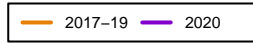
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Osprey

Pandion haliaetus



posterior distribution 95% CI
for interaction with
overlap includes zero

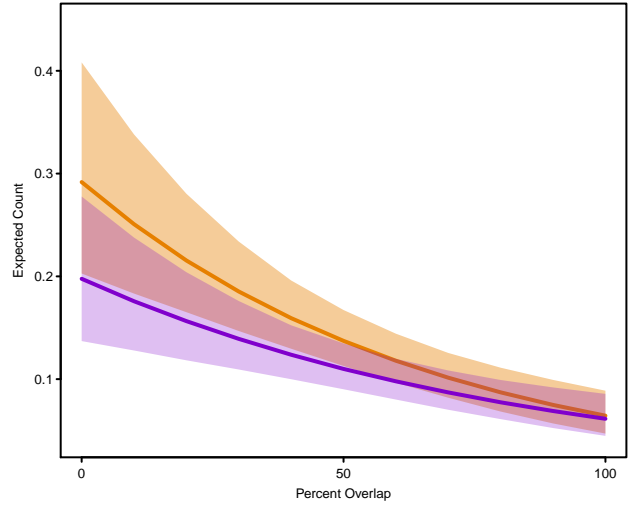
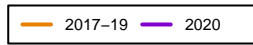
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

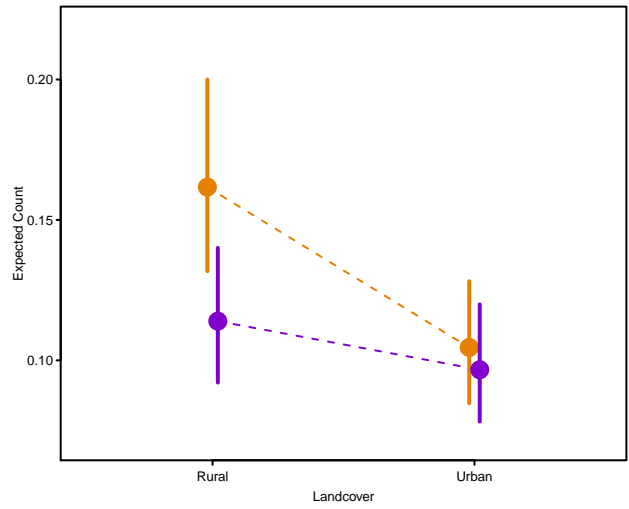
posterior distribution 95% CI
for interaction with
road includes zero

Palm Warbler

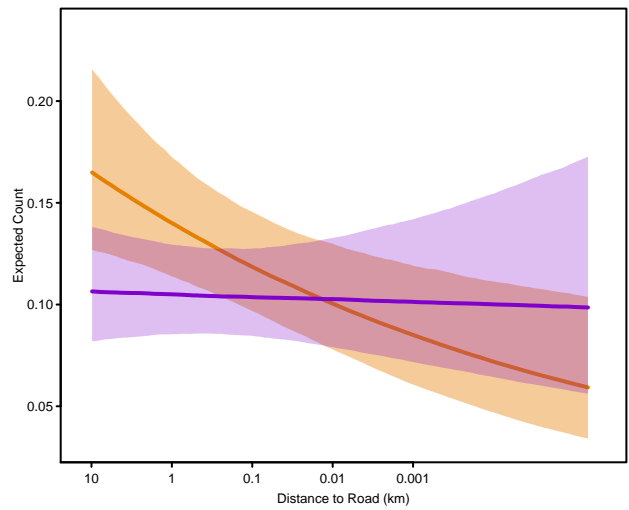
Setophaga palmarum



posterior distribution 95% CI
for interaction with
delta_traf includes zero

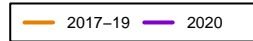


posterior distribution 95% CI
for interaction with
air includes zero



Pied-billed Grebe

Podilymbus podiceps



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

posterior distribution 95% CI
for interaction with
land includes zero

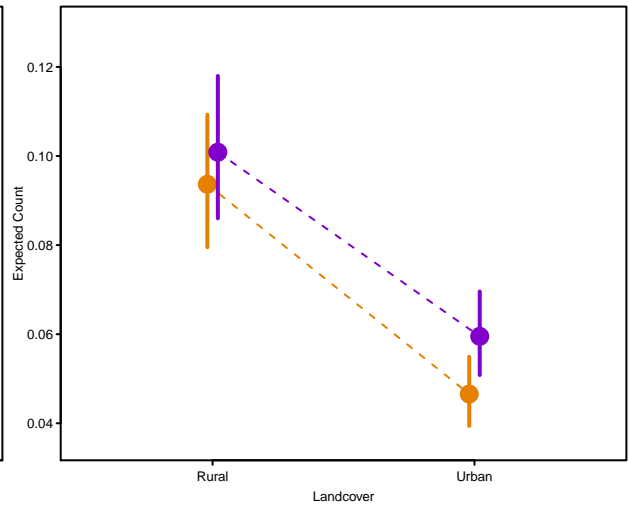
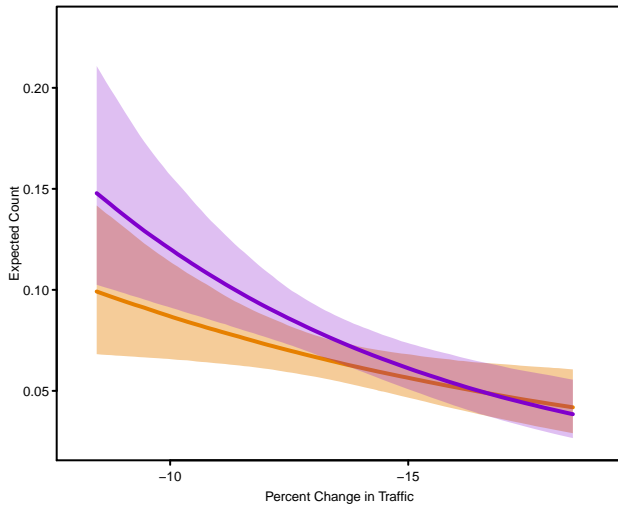
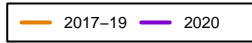
posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

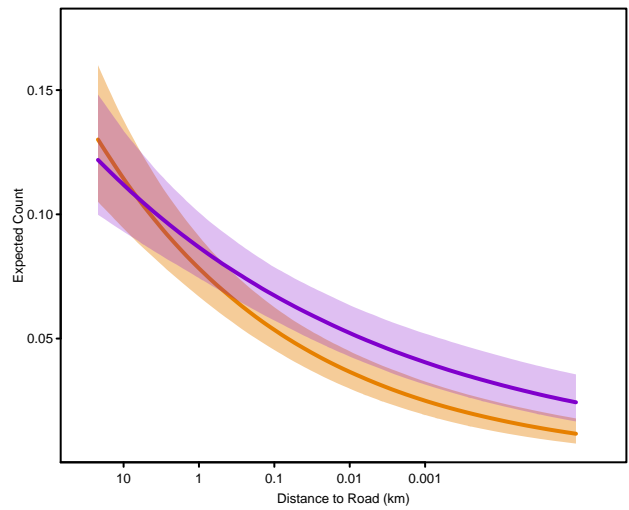
Pileated Woodpecker

Dryocopus pileatus

posterior distribution 95% CI
for interaction with
overlap includes zero



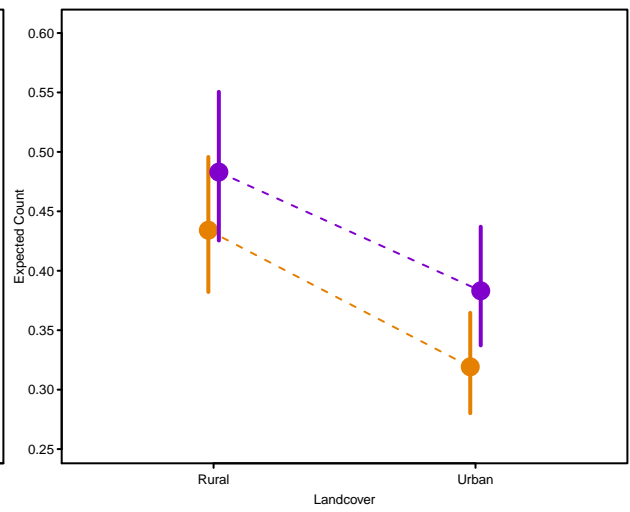
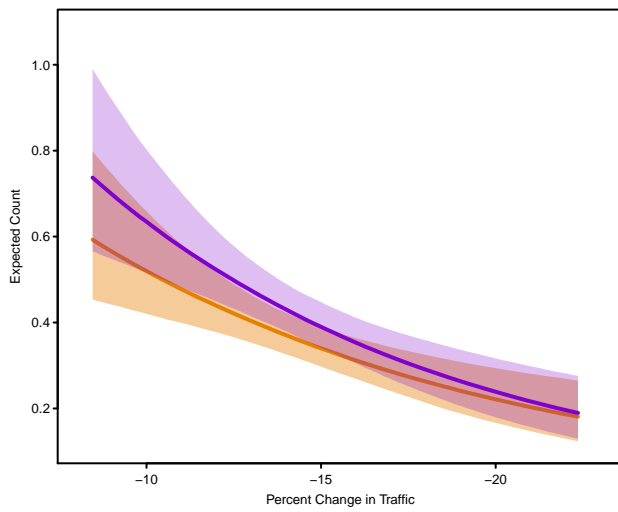
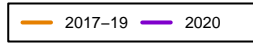
posterior distribution 95% CI
for interaction with
air includes zero



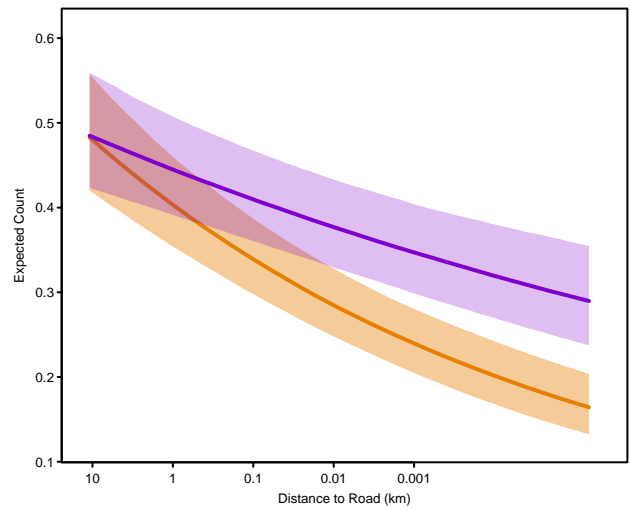
Red-bellied Woodpecker

Melanerpes carolinus

posterior distribution 95% CI
for interaction with
overlap includes zero

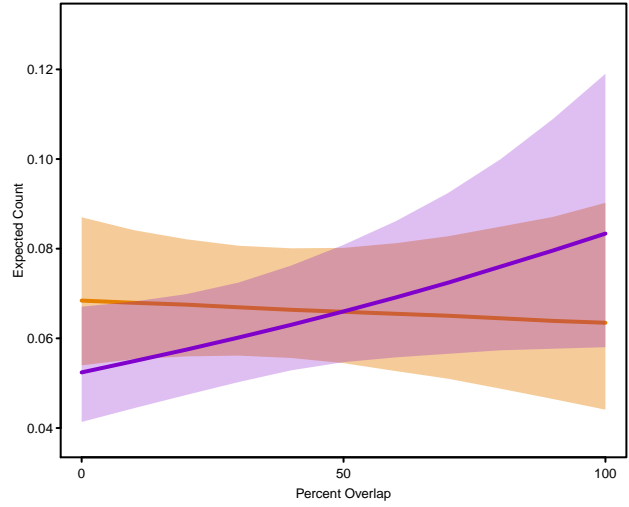
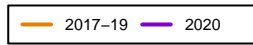


posterior distribution 95% CI
for interaction with
air includes zero



Red-eyed Vireo

Vireo olivaceus



posterior distribution 95% CI
for interaction with
delta_traf includes zero

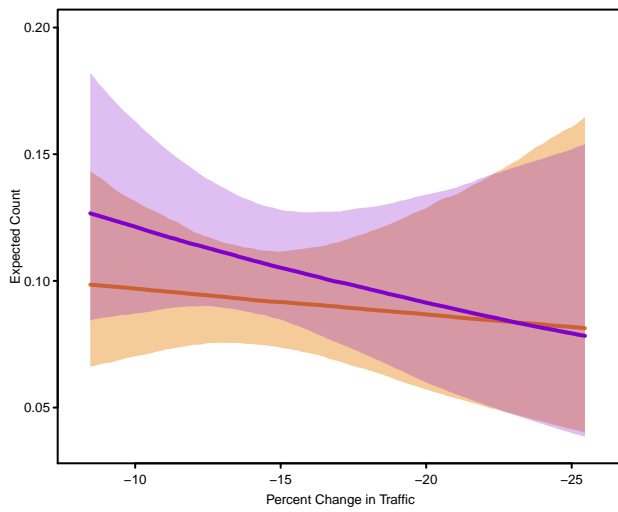
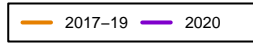
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Red-shouldered Hawk

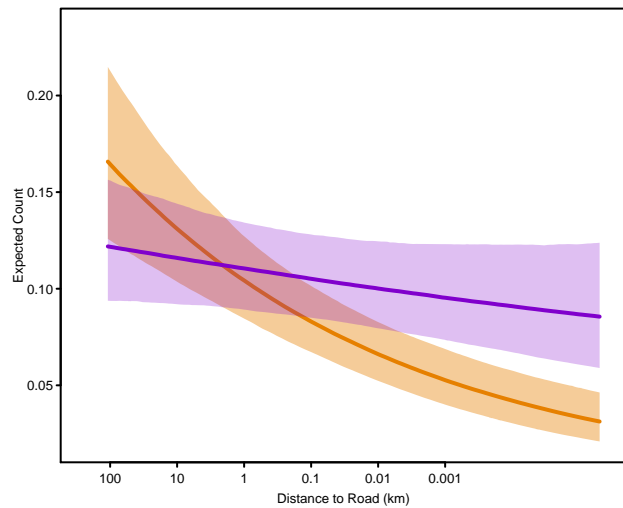
Buteo lineatus



posterior distribution 95% CI
for interaction with
overlap includes zero

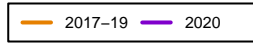
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero



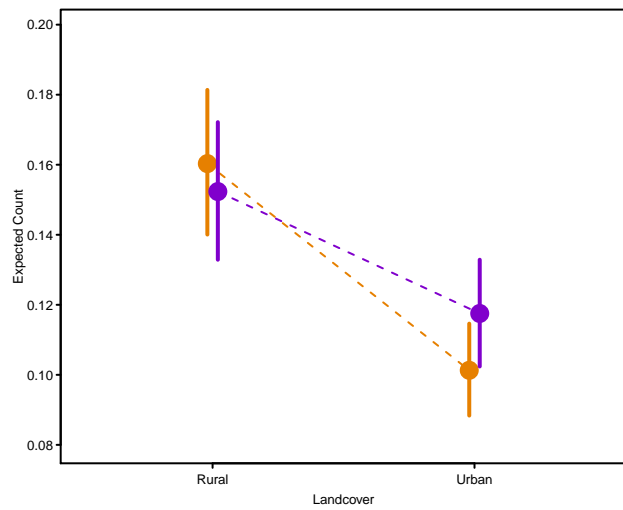
Red-tailed Hawk

Buteo jamaicensis

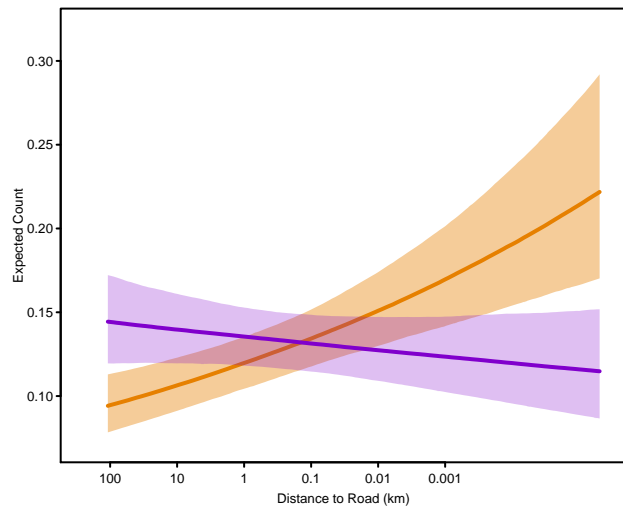


posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero



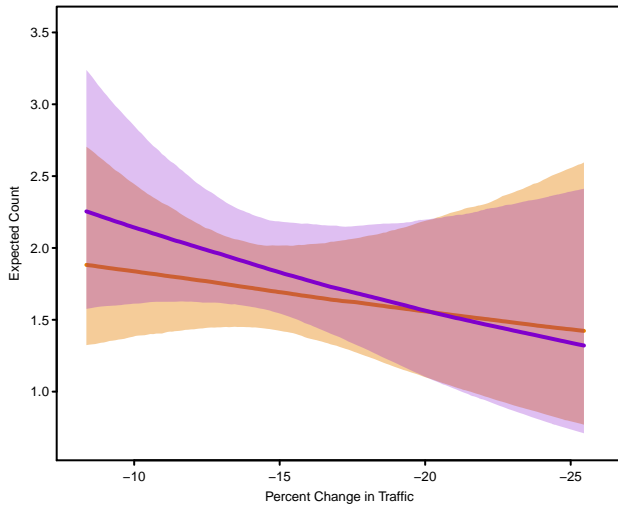
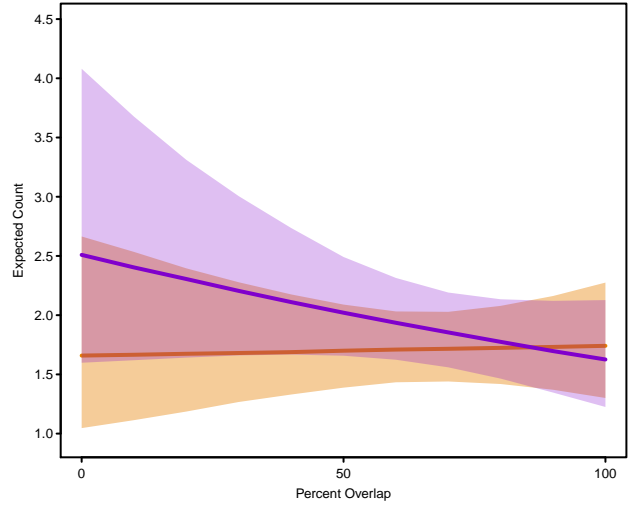
posterior distribution 95% CI
for interaction with
air includes zero



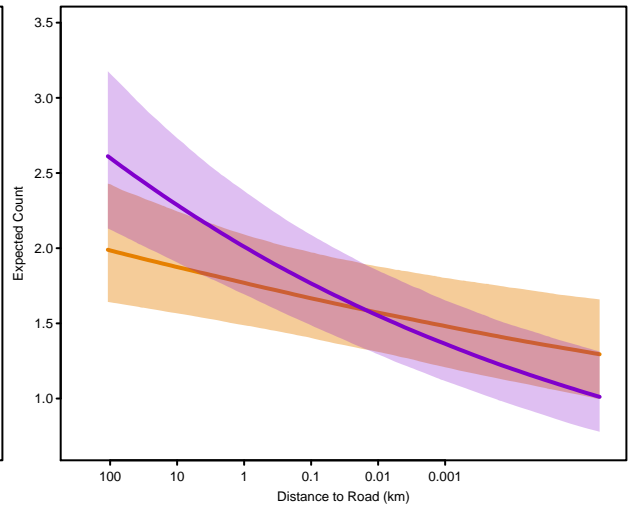
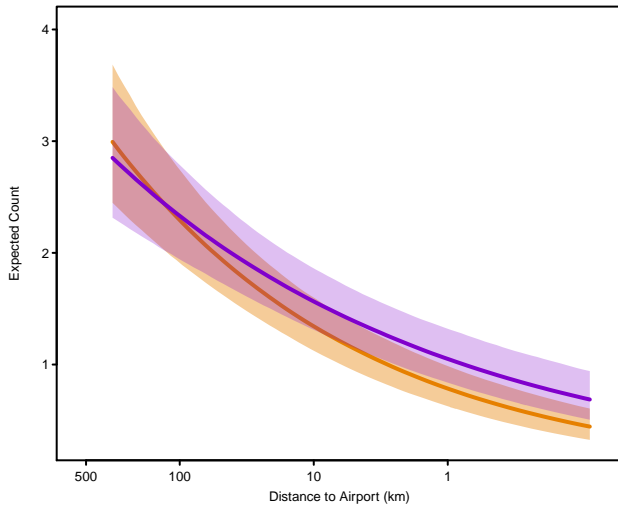
Red-winged Blackbird

Agelaius phoeniceus

2017-19 2020

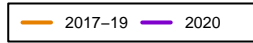


posterior distribution 95% CI
for interaction with
land includes zero



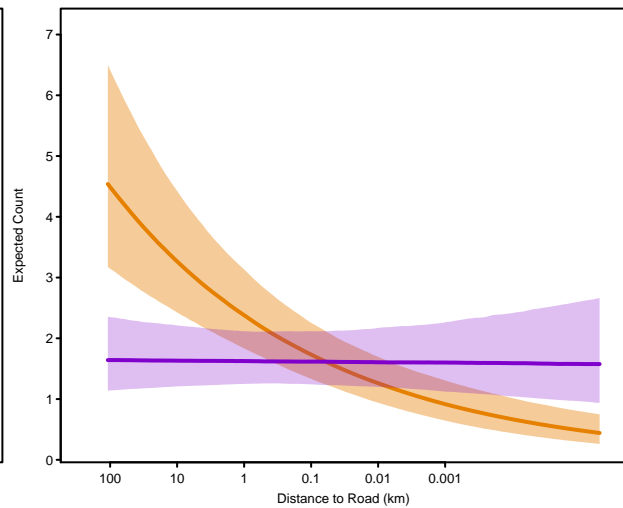
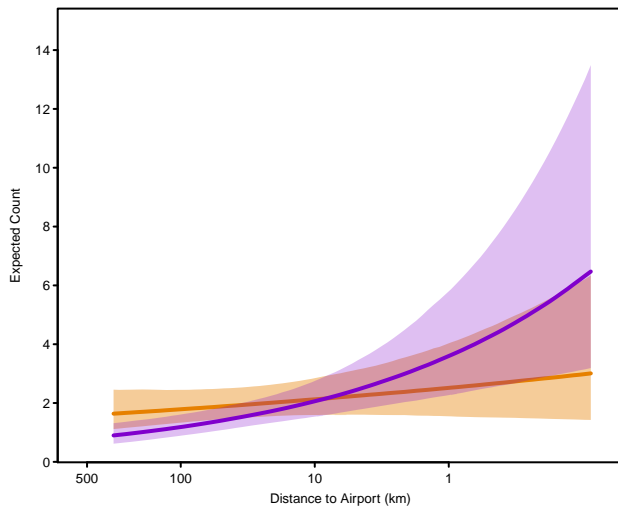
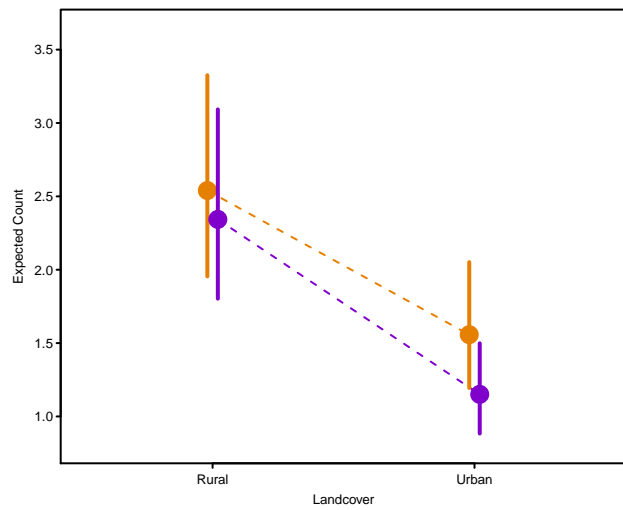
Ring-billed Gull

Larus delawarensis



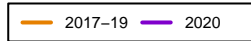
posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero



Rock Pigeon

Columba livia



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

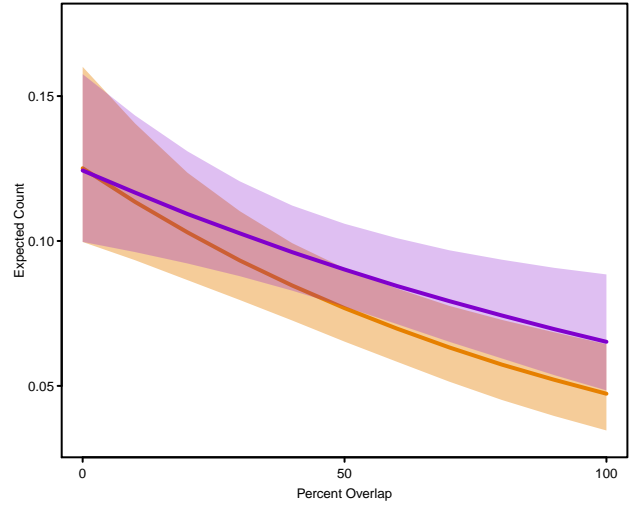
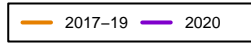
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Rose-breasted Grosbeak

Pheucticus ludovicianus



posterior distribution 95% CI
for interaction with
delta_traf includes zero

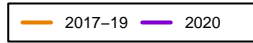
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Ruby-crowned Kinglet

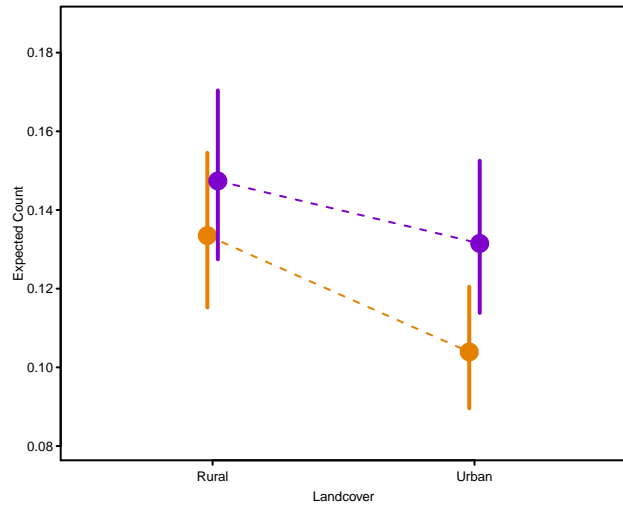
Regulus calendula



posterior distribution 95% CI
for interaction with
delta_traf includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
overlap includes zero

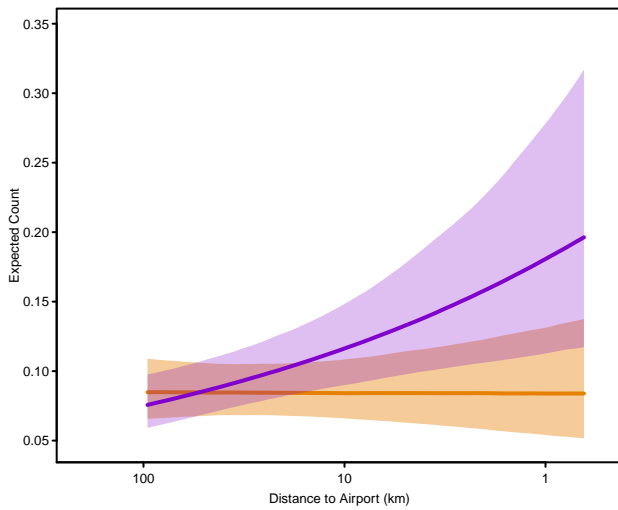
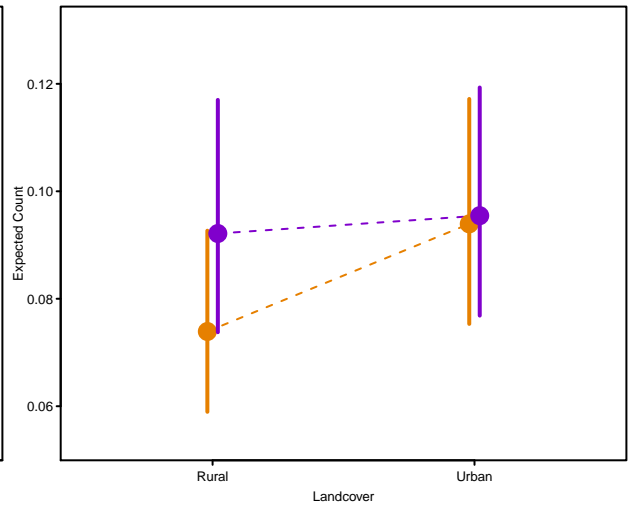
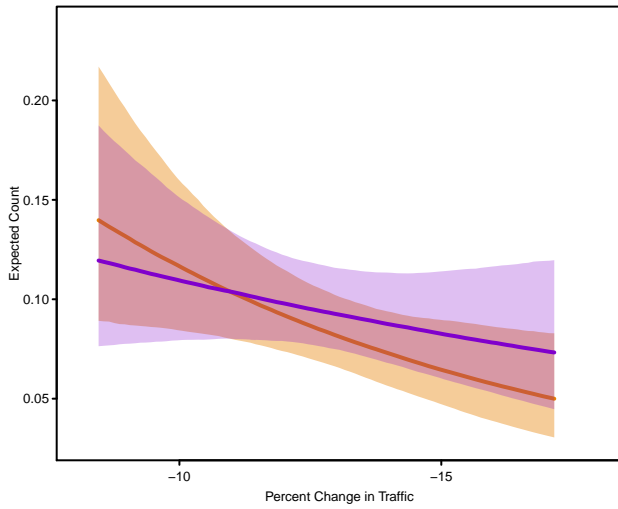
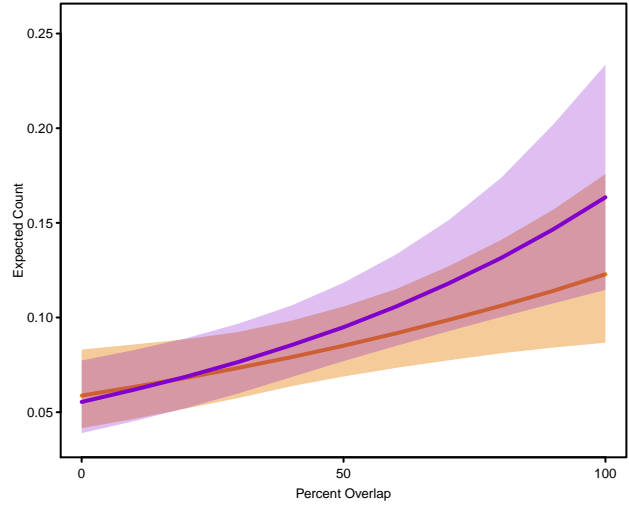


posterior distribution 95% CI
for interaction with
road includes zero

Ruby-throated Hummingbird

Archilochus colubris

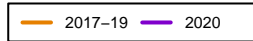
2017-19 2020



posterior distribution 95% CI
for interaction with
road includes zero

Snowy Egret

Egretta thula



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

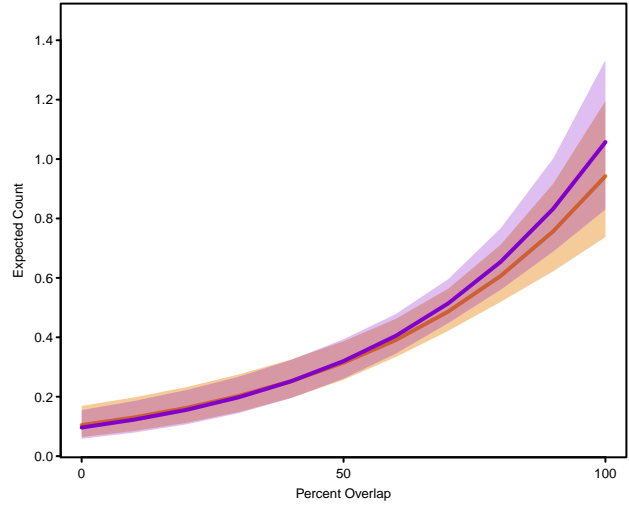
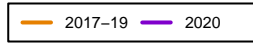
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Song Sparrow

Melospiza melodia



posterior distribution 95% CI
for interaction with
delta_traf includes zero

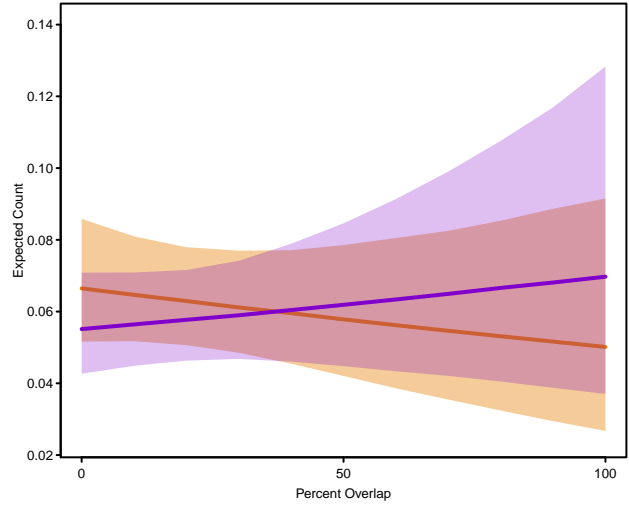
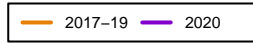
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Swainson's Thrush

Catharus ustulatus



posterior distribution 95% CI
for interaction with
delta_traf includes zero

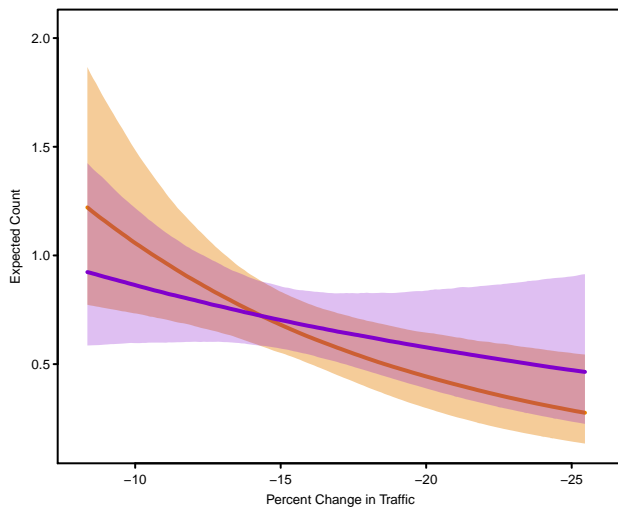
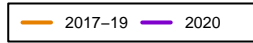
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Tree Swallow

Tachycineta bicolor



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
land includes zero

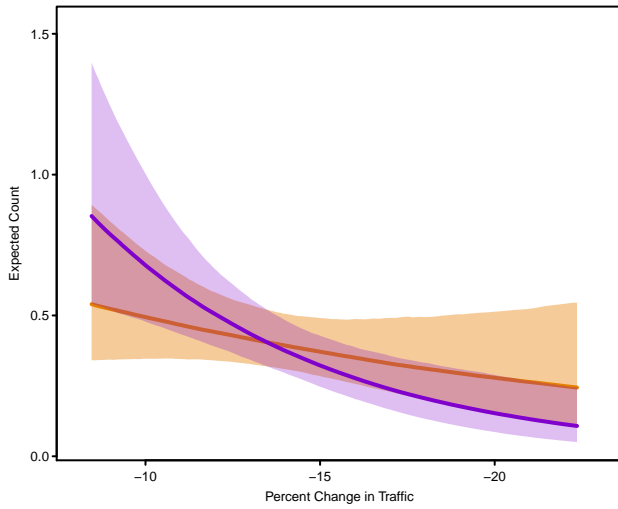
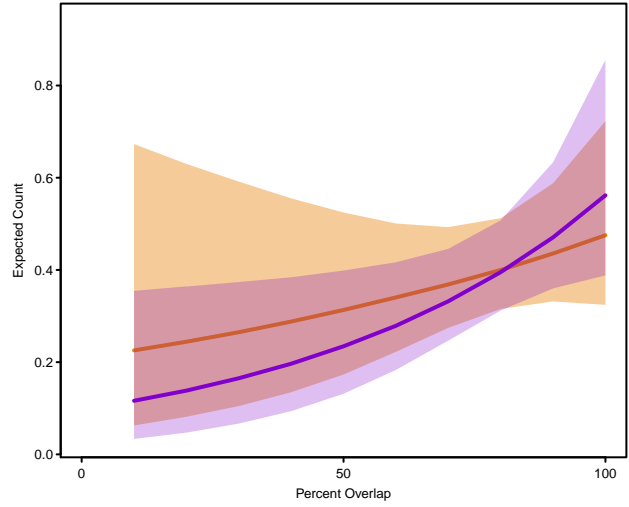
posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Tufted Titmouse

Baeolophus bicolor

2017-19 2020



posterior distribution 95% CI
for interaction with
land includes zero

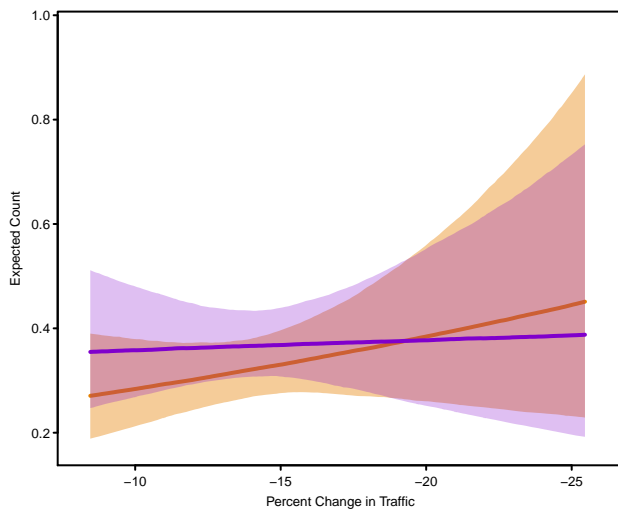
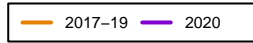
posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Turkey Vulture

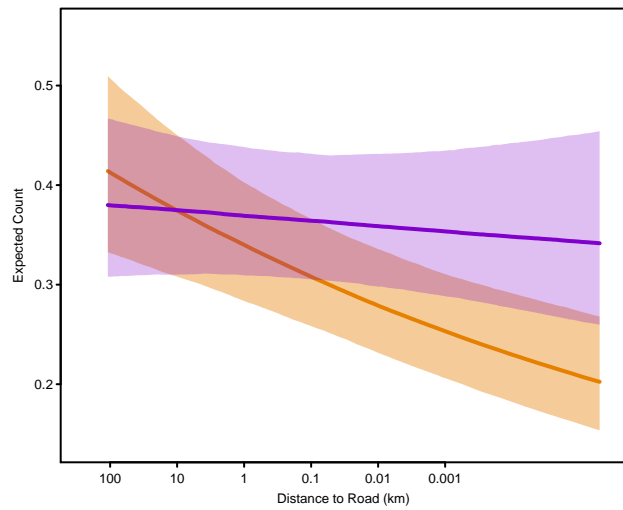
Cathartes aura

posterior distribution 95% CI
for interaction with
overlap includes zero



posterior distribution 95% CI
for interaction with
land includes zero

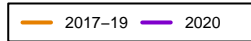
posterior distribution 95% CI
for interaction with
air includes zero



Warbling Vireo

Vireo gilvus

posterior distribution 95% CI
for interaction with
overlap includes zero



posterior distribution 95% CI
for interaction with
delta_traf includes zero

posterior distribution 95% CI
for interaction with
land includes zero

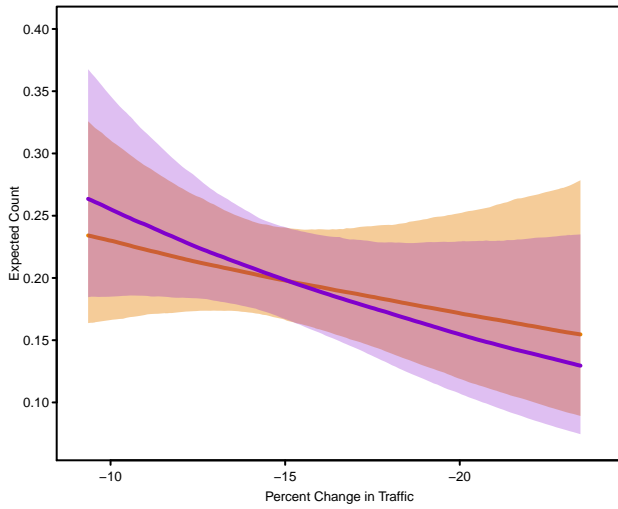
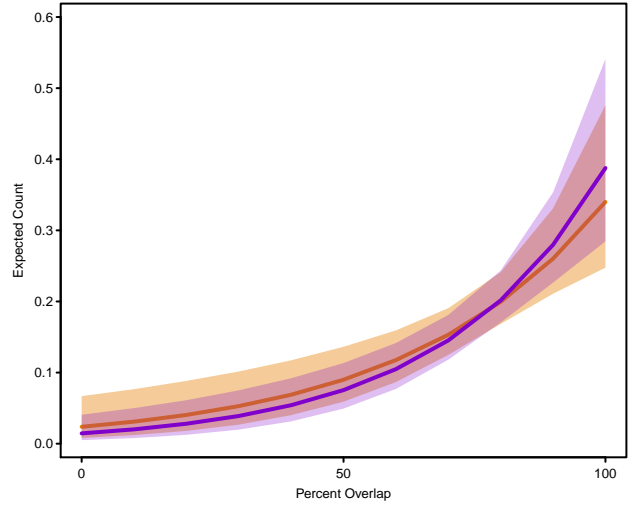
posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

White-breasted Nuthatch

Sitta carolinensis

2017-19 2020



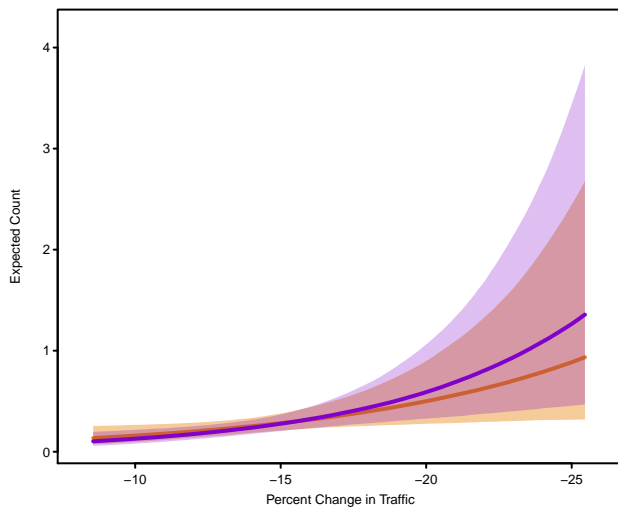
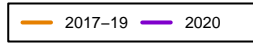
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

White-crowned Sparrow

Zonotrichia leucophrys



posterior distribution 95% CI
for interaction with
overlap includes zero

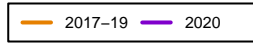
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

White-eyed Vireo

Vireo griseus



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
delta_traf includes zero

posterior distribution 95% CI
for interaction with
land includes zero

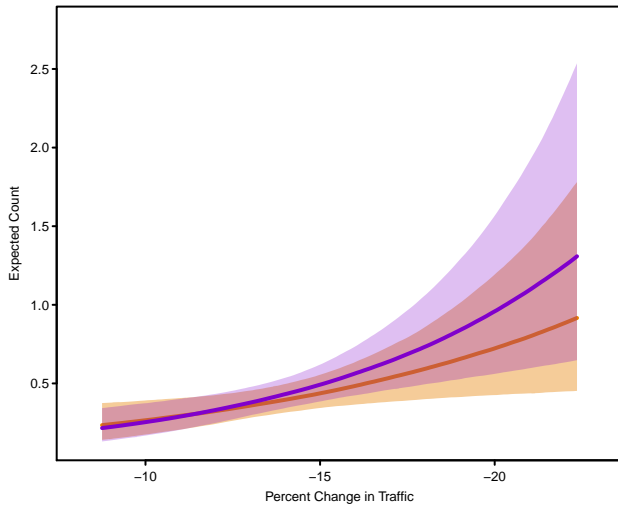
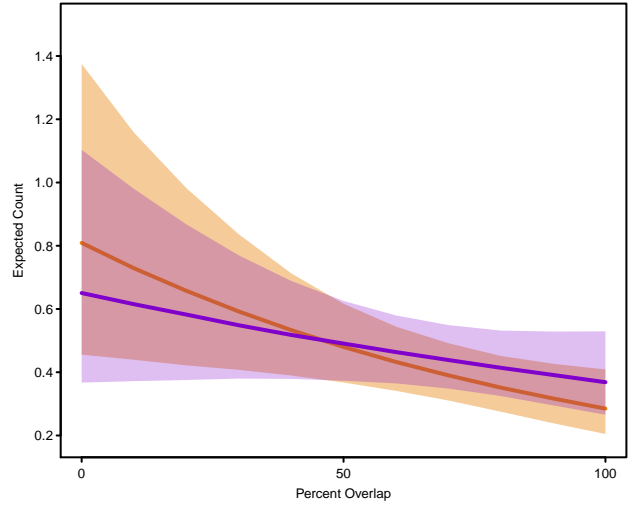
posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

White-throated Sparrow

Zonotrichia albicollis

2017-19 2020



posterior distribution 95% CI
for interaction with
land includes zero

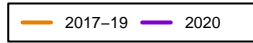
posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Wood Duck

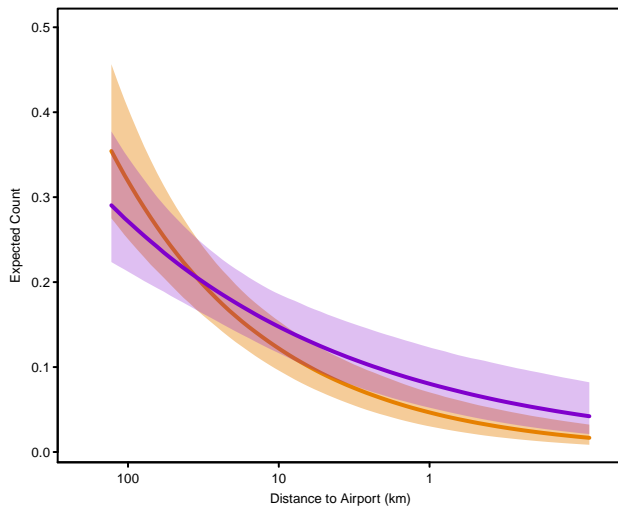
Aix sponsa

posterior distribution 95% CI
for interaction with
overlap includes zero



posterior distribution 95% CI
for interaction with
delta_traf includes zero

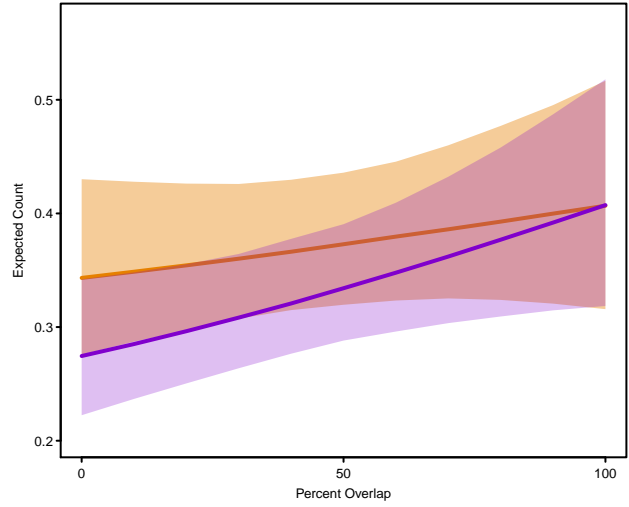
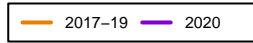
posterior distribution 95% CI
for interaction with
land includes zero



posterior distribution 95% CI
for interaction with
road includes zero

Yellow-rumped Warbler

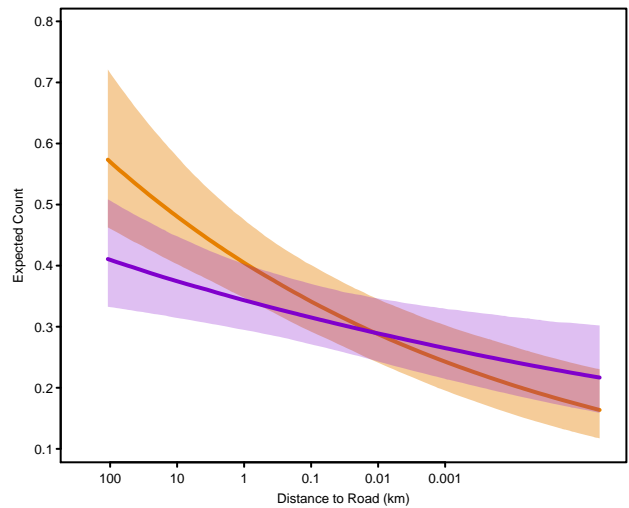
Setophaga coronata



posterior distribution 95% CI
for interaction with
delta_traf includes zero

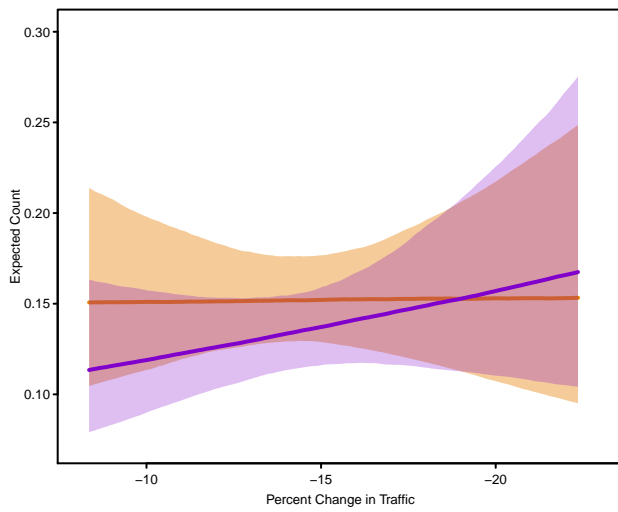
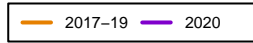
posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero



Yellow Warbler

Setophaga petechia



posterior distribution 95% CI
for interaction with
overlap includes zero

posterior distribution 95% CI
for interaction with
land includes zero

posterior distribution 95% CI
for interaction with
air includes zero

posterior distribution 95% CI
for interaction with
road includes zero

Table S1.

Summary statistics for variables used in the modeling process. Note that distances to airports and roads were logged for modeling (see Figs. S3-S4).

Variable	Type	Range	Mean (S.D)
County	Categorical, random	<i>n.a.</i>	<i>n.a.</i>
Pandemic	Categorical	Pre-, During-pandemic	<i>n.a.</i>
Distance (km)	Continuous	[0, 3]	0.757 (0.88)
Duration (min)	Continuous	[1, 300]	48.7 (47.5)
Change in Traffic (%)	Continuous, county specific	[-25.4, -8.37]	-14.3 (3.17)
Overlap (%)	Continuous, county specific	[0, 100]	65.2 (25.5)
Distance to airport (km)	Continuous	[0.09, 292]	35.0 (19.3)
Distance to road (km)	Continuous	(0, 98.2]	0.775 (2.18)
Landcover	Categorical	Urban, Rural	<i>n.a.</i>

Table S2.

Contingency table of the number of checklists (in all counties) that came from urban vs. rural habitat in each time period. Pearson's Chi-squared test with Yates' continuity correction ($\chi^2 = 0.0219$, $df = 1$, $p = 0.8824$).

Period	Urban	Rural
2017-2019	23064	21239
2020	23041	21262

Table S3.

Detectability values used for each species, calculations sensu (46), with data from the Canadian Wildlife Service and (49).

Species	Detectability	Species	Detectability
American crow	0.619	hairy woodpecker	0.217
American goldfinch	0.186	house sparrow	0.474
American redstart	0.255	house wren	0.595
American robin	0.451	indigo bunting	0.406
Baltimore oriole	0.357	killdeer	0.430
barn swallow	0.288	mallard	0.455
black-and-white warbler	0.249	mourning dove	0.571
black-capped chickadee	0.240	Nashville warbler	0.406
belted kingfisher	0.180	northern flicker	0.307
brown-headed cowbird	0.303	northern parula	0.327
blue jay	0.398	orange-crowned warbler	0.234
brown thrasher	0.533	palm warbler	0.278
blue-winged teal	0.440	pileated woodpecker	0.355
Canada goose	0.371	rose-breasted grosbeak	0.413
cedar waxwing	0.159	ruby-crowned kinglet	0.375
chipping sparrow	0.323	red-eyed vireo	0.520
common grackle	0.384	ruby-throated hummingbird	0.055
common yellowthroat	0.413	red-winged blackbird	0.546
dark-eyed junco	0.275	song sparrow	0.446
downy woodpecker	0.199	Swainson's thrush	0.430
eastern bluebird	0.165	tree swallow	0.406
eastern kingbird	0.370	warbling vireo	0.373
eastern phoebe	0.356	white-breasted nuthatch	0.265
eastern towhee	0.457	white-crowned sparrow	0.490
European starling	0.534	white-throated sparrow	0.460
great crested flycatcher	0.391	yellow warbler	0.388
gray catbird	0.277	yellow-rumped warbler	0.251

Table S4.

Impacts of detectability on the probability of species showing increases or any change in counts relative to lower human activity during the pandemic period ($n = 54$ species). LCL = lower 95% confidence limit, HCL = upper 95% confidence limit.

Variable	β	SE	p	LCL	HCL
<i>Were less detectable species more likely to show increased counts in areas with decreased human activity?</i>					
Urban-rural	-1.607	2.729	0.556	-6.955	3.741
Distance to airport	6.416	7.915	0.418	-9.097	21.930
Distance to road	-0.119	2.806	0.966	-5.619	5.381
Change in traffic	0.269	2.992	0.928	-5.595	6.132
Overlap migration-travel restrictions	-1.207	2.280	0.597	-5.675	3.261
<i>Were less detectable species more likely to show any change in counts in areas with decreased human activity?</i>					
Urban-rural	-3.803	2.563	0.138	-8.826	1.220
Distance to airport	4.317	3.417	0.206	-2.379	11.014
Distance to road	1.082	2.546	0.671	-3.908	6.071
Change in traffic	0.557	2.505	0.824	-4.352	5.466
Overlap migration-travel restrictions	-0.350	2.322	0.880	-4.902	4.201

Table S5.

Impacts of mean species body size on the probability of species showing increases or any change in counts relative to lower human activity during the pandemic period ($n = 82$ species). LCL = lower 95% confidence limit, HCL = upper 95% confidence limit.

Variable	β	SE	p	LCL	HCL
<i>Were smaller species more likely to show increased counts in areas with decreased human activity?</i>					
Urban-rural	0.003	0.175	0.987	-0.339	0.345
Distance to airport	0.357	0.152	0.019	0.059	0.656
Distance to road	0.090	0.152	0.553	-0.208	0.388
Change in traffic	-0.071	0.201	0.722	-0.464	0.322
Overlap migration-travel restrictions	-0.156	0.132	0.238	-0.414	0.103
<i>Were smaller species more likely to show any change in counts in areas with decreased human activity?</i>					
Urban-rural	0.069	0.135	0.612	-0.197	0.334
Distance to airport	0.289	0.145	0.047	0.004	0.574
Distance to road	0.101	0.140	0.472	-0.174	0.375
Change in traffic	-0.005	0.162	0.978	-0.322	0.313
Overlap migration-travel restrictions	-0.159	0.129	0.219	-0.412	0.094

Data S1. (separate file)

A list of all counties included in the modeling process with associated metadata.

Columns include:

County = county name

eBird_county_code = county code used in the eBird database

major_city = name of the major city located in the county

Country = country name

eBird_country_code = country code used in the eBird database

State = state/province name

eBird_state_code = state/province code used in the eBird database

latitude = latitude of a point in the center of the checklists from that county

longitude = longitude of a point in the center of the checklists from that county

Data S2. (separate file)

A list of all species included in the study with associated metadata.

Columns include:

eBird_species_code = 6-character taxonomic code used in the eBird database

common_name = English common name

scientific_name = scientific name

family = taxonomic family

band_code = 4-character banding code

notes = additional notes

Data S3. (separate file)

Comma separated value file with posterior summary statistics and convergence diagnostics for all modeled covariates. Column headers are constructed with abbreviations for *variable name* [hyphen] *statistic name*.

Variable names refer to:

dist = distance traveled

dur = duration

pandemic = main effect of pandemic (pre- vs post-pandemic)

overlap = main effect of overlap between peak traffic reduction and peak bird counts

delta_traf = main effect of traffic reduction

air = main effect of logged distance from airport

road = main effect of logged distance from road

land = main effect of local landcover (urban vs rural)

pandemic:overlap = interaction between pandemic and overlap

pandemic:delta_traf = interaction between pandemic and delta_traf

pandemic:air = interaction between pandemic and air

pandemic:road = interaction between pandemic and road

pandemic:land = interaction between pandemic and land

Statistic names refer to:

mean = mean

sd = standard deviation

lower = 2.5% quantile, i.e., lower limit of 95% credible interval

median = median, i.e. 50% quantile

upper = 97.5% quantile, i.e., upper limit of 95% credible interval

Rhat = \hat{R} value, used to check convergence

ESS = crude measure of effective sample size of the posterior

Data S4. (separate file)

R script file containing code used to extract and filter eBird data, prepare individual species data files, run each single-species model using the rstanarm interface with the Stan language, and interpret results.