

## Supplement 2

Supplementary information for McGowan et al. “Linking monitoring and data analysis to predictions and decisions for a range-wide eastern Black Rail status assessment” including tables to identify covariates and covariate data sources for the occupancy and projection modeling analysis.

Table S1: Covariates focused on precipitation and temperature as potentially important predictors of site extinction probability and site colonization probability. *Current* covariates used in testing hypotheses for black rail habitat associations and *future* covariates refer to information used in future condition projection models.

<b>THEME</b>	<b>Current</b>	<b>Future</b>	<b>Scale</b>	<b>Source</b>
<b>ALTERED PLANT COMMUNITIES/ INVASIVE PLANTS</b>	National Land Cover Database; Soil Survey of the United States	NLCD change rate increase	30 square meters	Homer et al. 2015, (Soil Survey Staff 2017)
<b>ALTERED FIRE REGIME</b>	Drought Severity Index during breeding season	Not modeled	Not modeled	National Drought Mitigation Center (www.drought.gov)
<b>HABITAT CONVERSION</b>	Urban land change	SLEUTH	NLCD: 30 square meters, Sleuth: 60 square meters	Homer et al. 2015, SLEUTH, 2017
<b>HABITAT MANAGEMENT</b>	Total farms in acres +	Increase by paper rates: + rangeland	National-level	Thornton, 2010

	rangeland	conversion		
<b>HABITAT FRAGMENTATION</b>	Impervious surface change for trend data	Increase by SLEUTH	60 square meters	SLEUTH
<b>ALTERED HYDROLOGY</b>	HUC, NWI, Sea level rise (baseline), groundwater depletion rates	HUC, NWI, Sea level rise, groundwater trends	1 square degree (p. 43)	Sweet et al. 2017
<b>COMPETITION &amp; PREDATION</b>	Fire ant species distribution model	Increase to hard northern limit in maps	State-level	Korzukhin et al., 2001
<b>CLIMATE AND WEATHER EXTREMES</b>	Climate during breeding season 2008 - 2017; FLOOD FREQUENCY (2010 - 2015)	Rates trending with Climate during breeding season 2008 - 2017; FLOOD FREQUENCY	State-level	Young et al. 2017

<b>HUMAN-BLACK RAIL INTERACTIONS</b>	Proportion overlay of protected areas and black rail occurrence	Increase at rate determined by encounter rates in eBird	State-level	eBird, National Gap Analysis Project Protected Areas Data Portal
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DISEASE	No	No	Not modeled	Not modeled
<b>OIL, CHEMICAL SPILLS AND TOXICS</b>	Count	No	National-level	NOAA Office of Response and Restoration

Table S2: Top six competing Great Plains candidate models, AIC model ranking and parameter estimates.

Great Plains Model Selection						
Model	nPars	AIC	delta	AICwt	cumlvtWt	
psi(.)gam(.)eps(.)p(.)	4	59.28	0	0.8774	0.88	
psi(.)gam(WP)eps(WP)p(Y)	9	64.67	5.39	0.0592	0.94	
psi(.)gam(FA)eps(FA)p(Y)	9	66.9	7.62	0.0194	0.96	
psi(.)gam(AP)eps(AP)p(Y)	9	66.91	7.63	0.0193	0.98	
psi(.)gam(FA+WP)eps(FA+WP)p(Y)	11	68.67	9.39	0.008	0.98	
psi(.)gam(Y)eps(Y)p(Y)	11	70.02	10.74	0.0041	0.99	
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Great Plains parameter estimates	estimate	SE	UB	LB		
Initial Occupancy (psi)	0.131	0.0747	0.277412	-0.01541		
Extinction (eps)	0.317	0.217	0.74232	-0.10832		
Colonization (gam)	4.78E-05	0.00124	0.002478	-0.00238		
Detection (p)	0.263	0.11	0.4786	0.0474		

Table S3: Top five Southwest candidate models, model ranking and parameter estimates.

Texas (Southwest) Model Selection:						
Model	nPars	AIC	delta	AICwt	cumlvtWt	
psi(.)gam(RT)eps(RT)p(Y)	7	721.44	0	0.54252	0.54	
psi(.)gam(CT)eps(CT)p(Y)	7	723.44	2	0.19941	0.74	
psi(.)gam(.)eps(.)p(.)	4	723.7	2.27	0.17474	0.92	
psi(.)gam(FA+RT)eps(FA+RT)p(Y)	9	725.39	3.95	0.0752	0.99	
psi(.)gam(AP)eps(AP)p(Y)	7	730.63	9.19	0.00548	1	
....						
Southwest parameter estimates	estimate	SE	UB	LB		
Initial Occupancy (psi)	0.247	0.0481	0.341276	0.152724		
Extinction (eps)	0.612	0.126	0.85896	0.36504		
Colonization (gam)	0.138	0.0419	0.220124	0.055876		
Detection (p)	0.235	0.0415	0.31634	0.15366		

Table S4: Top five Southeast candidate models, model ranking and parameter estimates.

Southeast Model Selection					
Model	nPars	AIC	delta	AICwt	cumltvWt
psi(.)gam(Y)eps(Y)p(Y)	11	768.01	0	9.80E-01	0.98
psi(.)gam(.)eps(Y)p(Y)	9	776.06	8.05	1.70E-02	0.99
psi(.)gam(FA)eps(FA)p(Y)	9	778.06	10.6	4.90E-03	1
psi(.)gam(FA+Y)eps(FA+Y)p(Y)	13	784.07	16.06	3.20E-04	1
psi(.)gam(S)eps(S)p(Y)	9	800.15	32.13	1.00E-07	1
....					
Southeast parameter estimates					
estimate	SE	UB	LB		
Initial Occupancy (psi)	0.099	0.007	0.112	0.086	
Extinction (eps) year 1	0.570	0.165	0.893	0.247	
Extinction (eps) year 2	0.490	0.114	0.713	0.267	
Extinction (eps) year 3	0.001	0.044	0.087	0.000	
Colonization (gam) year 1	3.80E-02	3.20E-11	0.038	0.038	
Colonization (gam) year 2	1.00E-08	3.12E-06	6.13E-06	0.000	
Colonization (gam) year 3	1.90E-19	9.62E-17	1.89E-16	0.000	
Detection (p) year 1	0.090	0.016	0.121	0.059	
Detection (p) year 2	0.530	0.049	0.626	0.434	
Detection (p) year 3	0.299	0.061	0.419	0.179	
Detection (p) year 4	0.204	0.051	0.304	0.104	

Tables S2-4 abbreviations:

- psi initial occupancy probability
- gam colonization probability
- eps extinction probability (Persistence is 1-extinction probability)
- p detection probability
- . a parameter with no covariates
- Y year specific parameter
- WP wettest month precipitation
- AP Annual precipitation
- FA fire ants (presence/absence)
- RT Temperature range
- CT coldest month mean temperature
- S State (e.g., SC, GA, TX)
- MT Annual mean temperature

..... Indicates that additional models were evaluated but we did not include them here because they garnered no support in the analysis.

Additional Literature not cited in the main text of the paper:

Homer CG, Dewitz JA, Yang L, Jin S, Danielson P, Xian G, Coulston J, Herold ND, Wickham JD, Megown K. (2015) Completion of the 2011 National Land Cover Database for the conterminous United States—Representing a decade of land cover change information: *Photogrammetric Engineering and Remote Sensing* 81: 345–354.

Korzukhin, M D, Porter SD, Thompson LC, and Wiley S. (2001) Modeling Temperature-Dependent Range Limits for the Red Imported Fire Ant (Hymenoptera: Formicidae: *Solenopsis invicta*) in the United States. *Environmental Entomology* 30: 645-655.

National Drought Mitigation Center ([www.drought.gov](http://www.drought.gov))

National Gap Analysis Project Protected Areas Data Portal (<https://gapanalysis.usgs.gov/padus/>)

Sweet WV, Kopp RE, Weaver CP, Obeysekera J, Horton RM, Theiler RE, Zervas C (2017) Global and Regional Sea Level Rise Scenarios for the United States, NOAA Technical Report NOS CO-OPS 083 ([https://tidesandcurrents.noaa.gov/publications/techrpt83\\_Global\\_and\\_Regional\\_SLR\\_Scenarios\\_for\\_the\\_US\\_final.pdf](https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf))

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Thornton PK. (2010) Livestock production: recent trends, future prospects. *Philosophical Transactions of the Royal Society B: Biological Sciences* 365:2853-67.

SLEUTH (2014) SLEUTH Projected Urban Growth, <https://databasin.org/datasets/e5860ced8b4844e88431cdbefe425e1a>

Soil Survey Geographic Database (SSURGO; NRCS, 2017)

Soil survey Staff, Natural Resources Conservation Service, U.S. Department of Agriculture. Web

Soil Survey Available online at: <https://websoilsurvey.nrcs.usda.gov>.

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