Table S4. Model comparisons for Lyme disease and babesiosis. (We fitted a series of nested models and evaluate model fit with ΔDIC compared with the non-spatial process-based model. Process-based models include: (i) a non-spatial process model; (ii) a spatial model allowing for linear dependence of invasion mechanisms on local infection risk; (iii) a full covariate model including nonlinear dependence of invasion mechanisms on local infection risk and ecological covariates; (iv) a parsimonious model excluding any covariate from the full covariate model with a 95% credible interval that includes 0; and (v) a parsimonious model without the observation process. To justify modelling latent ecological processes, we also present results of fitting a 'null' phenomenological model described in the electronic supplementary material, text S1. All models estimate *B*, the coefficient for population size offset.)

	model description	observation parameter	ecological parameters	DIC	ΔDIC
Lyme disease					
process-based model	non-spatial	r_s	$\mathbf{p}$, ϕ_0, γ_0, θ_0	17 462	—
	linear spatial dependence	r_s	$\mathbf{p}$, ϕ_0, ϕ_1, γ_0, γ_1, θ_0, θ_1	14 774	2688
	full covariate	r_s	$\mathbf{p}$, ϕ_0, ϕ_1, ϕ_2, ϕ_3, $\phi_4\gamma_0$, γ_1, γ_2, γ_3, γ_4, θ_0, θ_1, θ_2, θ_3, θ_4	14 321	3141
	parsimonious model	r_s	$\mathbf{p}$, ϕ_0, ϕ_1, ϕ_2, ϕ_3, γ_0, γ_1, γ_2, θ_0, θ_1, θ_3	14 316	3146
	parsimonious no observation	r_s	$\mathbf{p}$, ϕ_0, ϕ_1, ϕ_2, ϕ_3, γ_0, γ_1, γ_2, θ_0, θ_1, θ_3	14 333	3129
	null	r_s	τ_0, τ_1, τ_2	16 214	1248
babesiosis					
process-based model	non-spatial	r_s	$\mathbf{p}$, ϕ_0, γ_0, θ_0	8691	—
	linear spatial dependence	r_s	$\mathbf{p}$, ϕ_0, ϕ_1, γ_0, γ_1, θ_0, θ_1	8038	653
	full covariate	r_s	$\mathbf{p}$, ϕ_0, ϕ_1, ϕ_2, ϕ_3, ϕ_4, ϕ_5, γ_0, γ_1, γ_2, γ_3, γ_4, γ_5, θ_0, θ_1, θ_2, θ_3, θ_4, θ_5	7293	1398
	parsimonious model	r_s	$\mathbf{p}$, ϕ_0, ϕ_1, ϕ_3, ϕ_4, ϕ_5, γ_0, γ_1, γ_2, γ_4, γ_5, θ_0, θ_1, θ_4	7287	1404
	parsimonious, no observation		$\mathbf{p}$, ϕ_0, ϕ_1, ϕ_3, ϕ_4, ϕ_5, γ_0, γ_1, γ_2, γ_4, γ_5, θ_0, θ_1, θ_4	7355	1336
	null	r_s	τ_0, τ_1, τ_2	8634	57