

Overview of the structure of HMSC

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Overview of the structure of HMSC

HMSC is a multivariate hierarchical generalized linear mixed model fitted with Bayesian inference

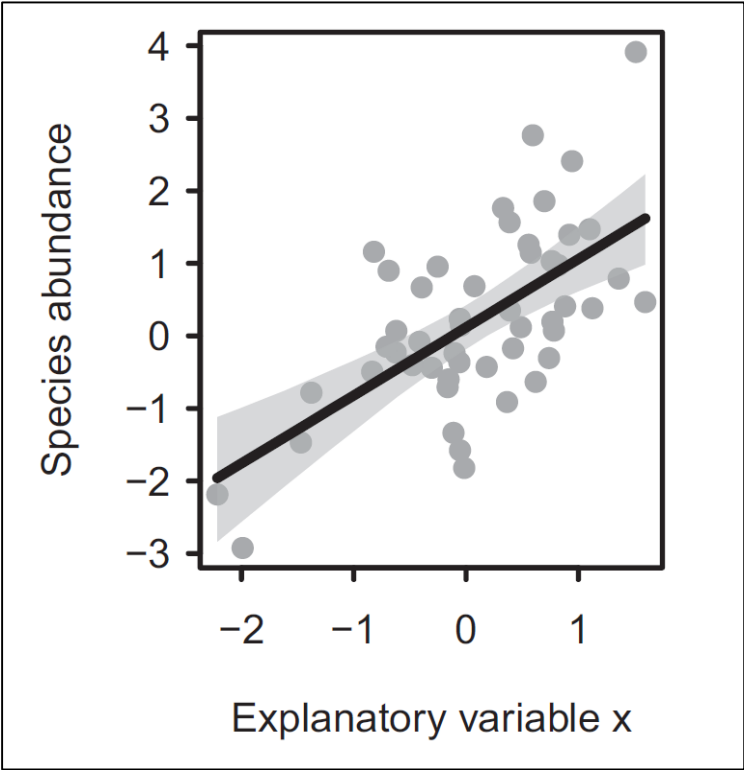
Table 4.1 *Definitions of statistical frameworks as used in this book.*

Name of the statistical framework as used in this book	Number of explanatory variables	Types of explanatory variables	Number of response variables	Types of response variables	Random effects	Introduced in
Linear model	Zero or more	Continuous or categorical	One	Only normally distributed	Does not include	Section 5.2
Generalised linear model	Zero or more	Continuous or categorical	One	Can be non-normally distributed	Does not include	Section 5.3
Linear mixed model	Zero or more	Continuous or categorical	One	Only normally distributed	Can include	Section 5.4
Generalised linear mixed model	Zero or more	Continuous or categorical	One	Can be non-normally distributed	Can include	Section 5.4
Multivariate linear model	Zero or more	Continuous or categorical	One or more	Only normally distributed	Does not include	Section 6.1
Multivariate generalised linear model	Zero or more	Continuous or categorical	One or more	Can be non-normally distributed	Does not include	Section 6.1
Multivariate linear mixed model	Zero or more	Continuous or categorical	One or more	Only normally distributed	Can include	Section 7.3
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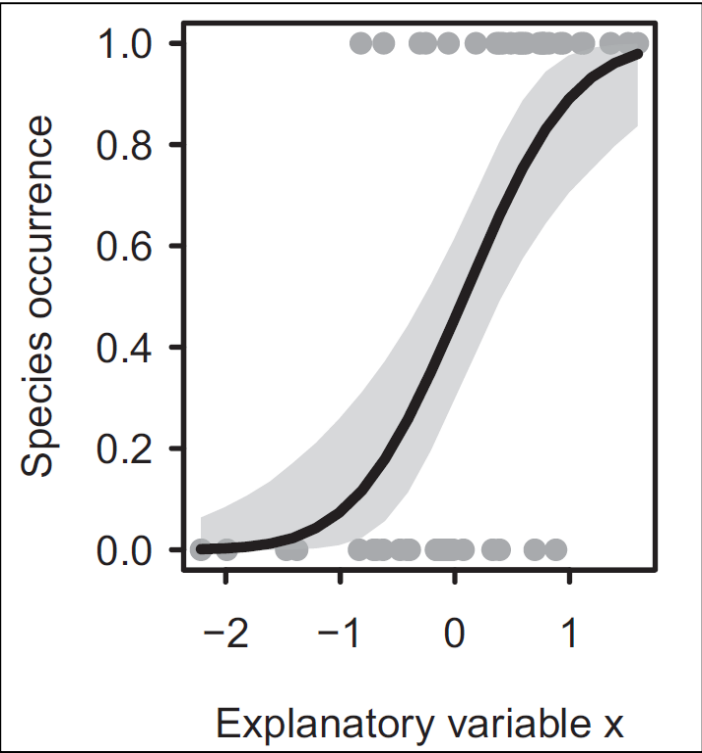
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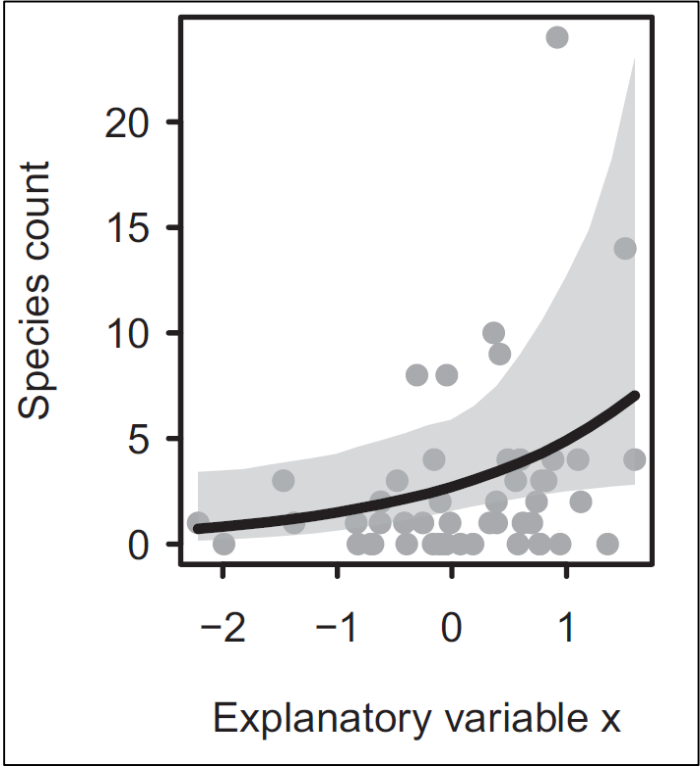
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OR

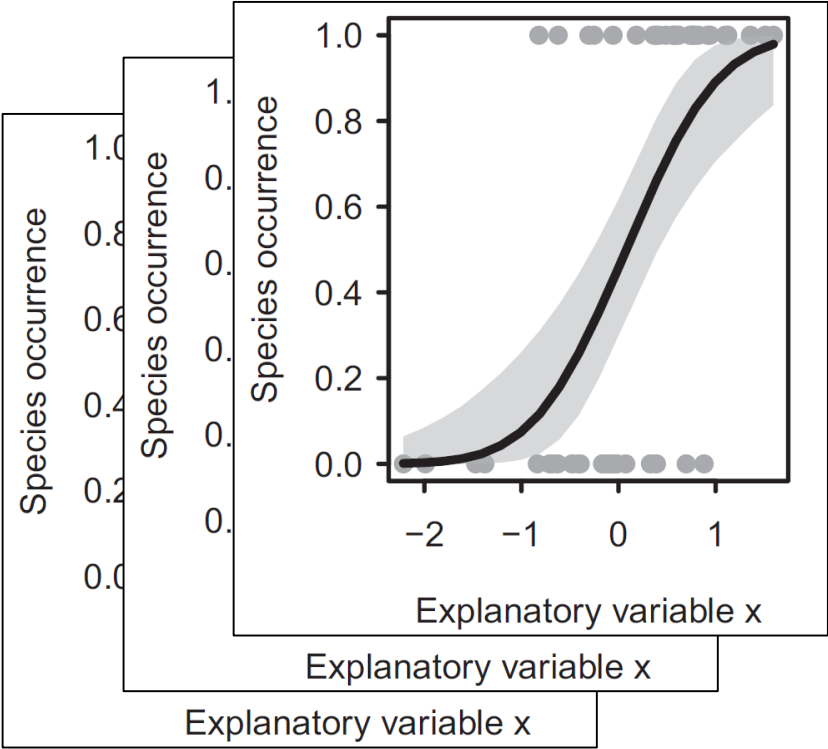


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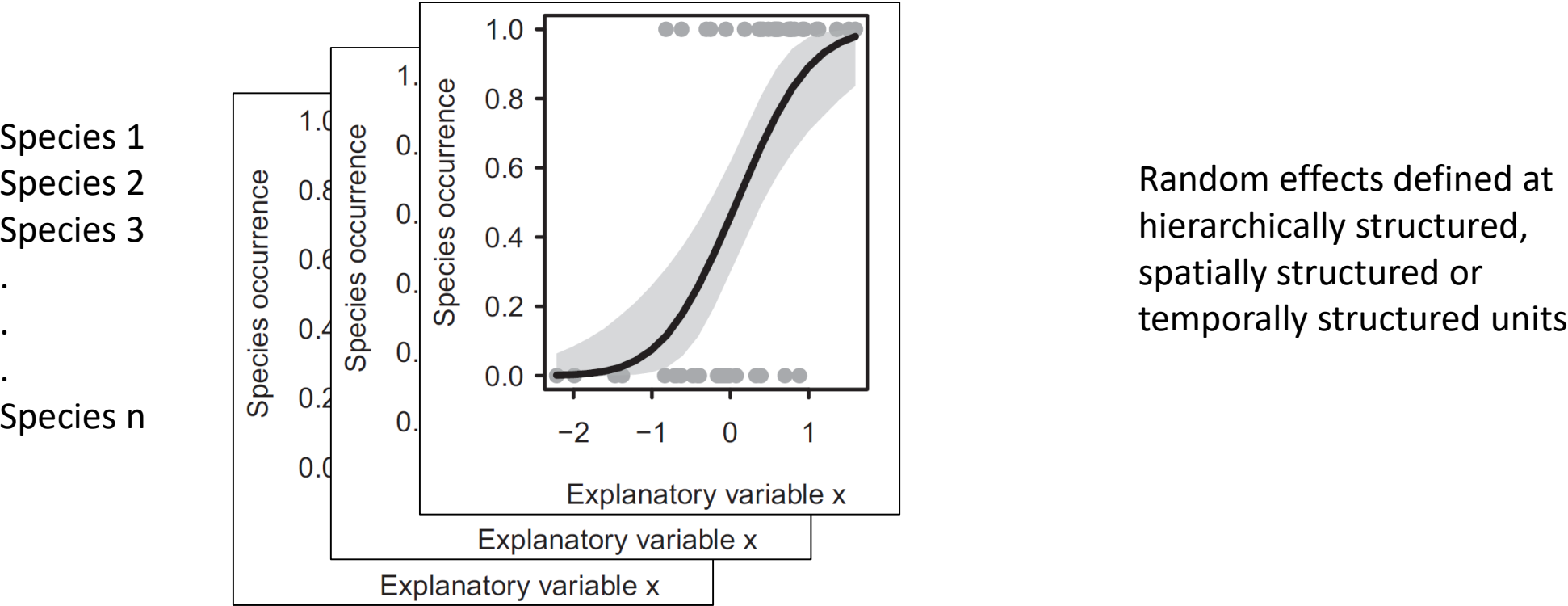
Species 1
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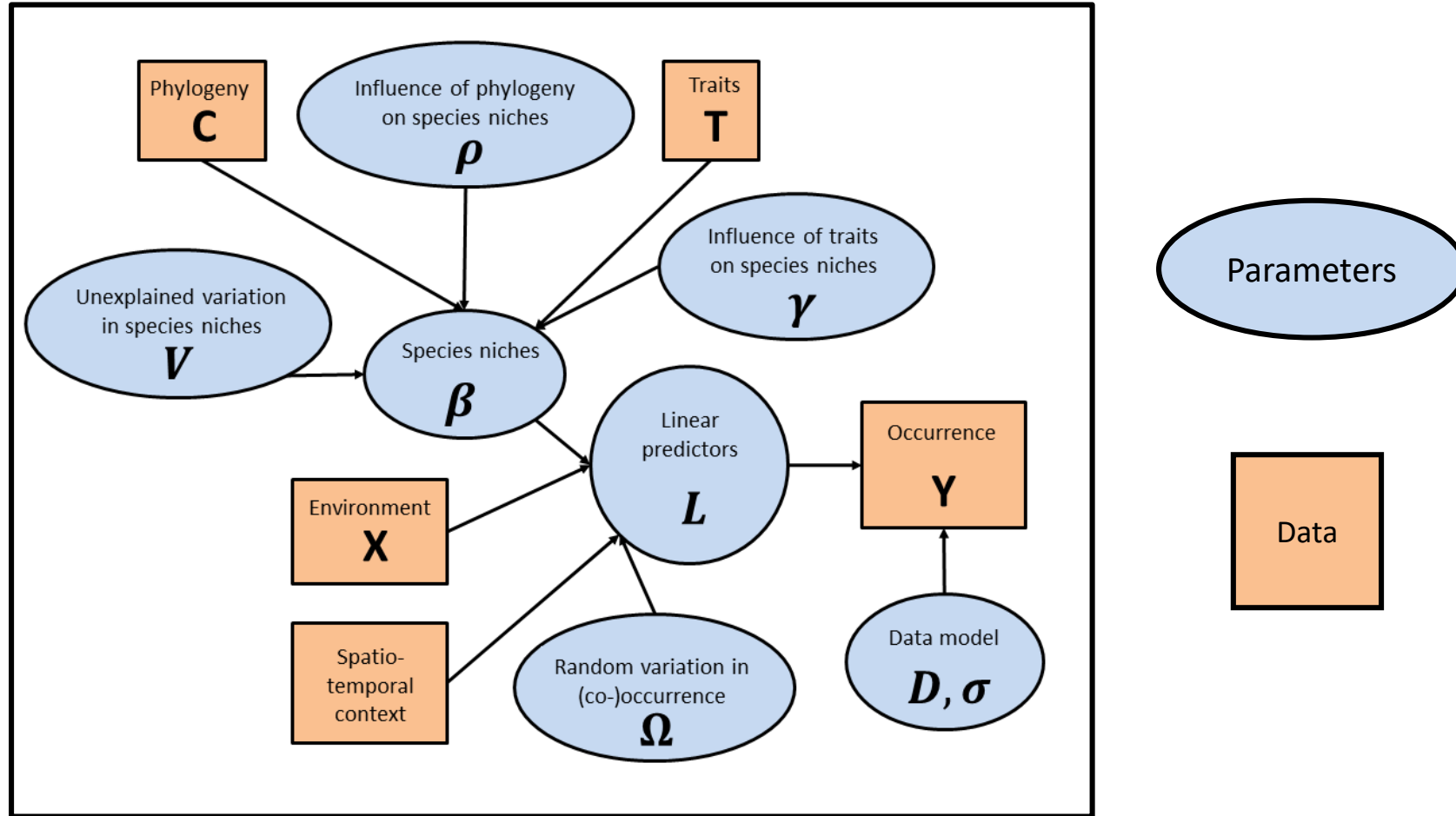
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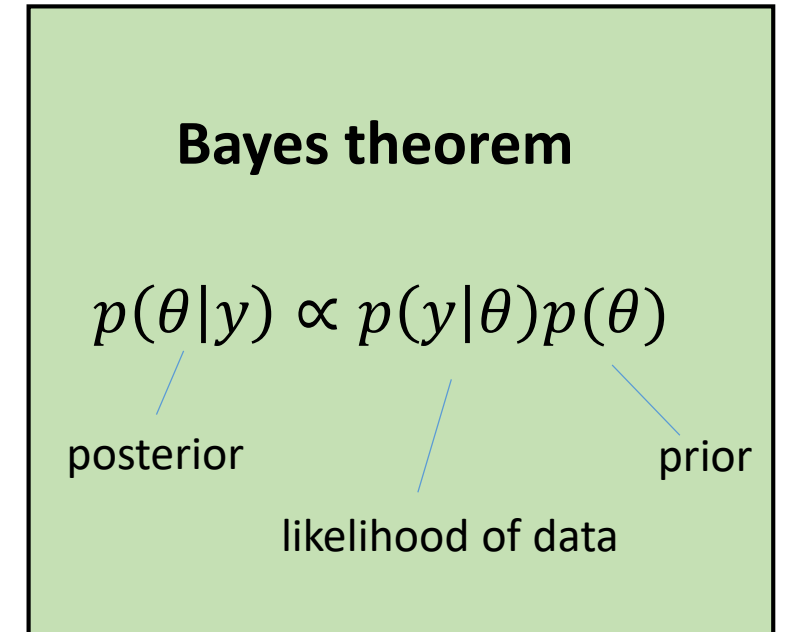
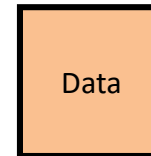
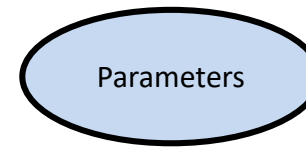
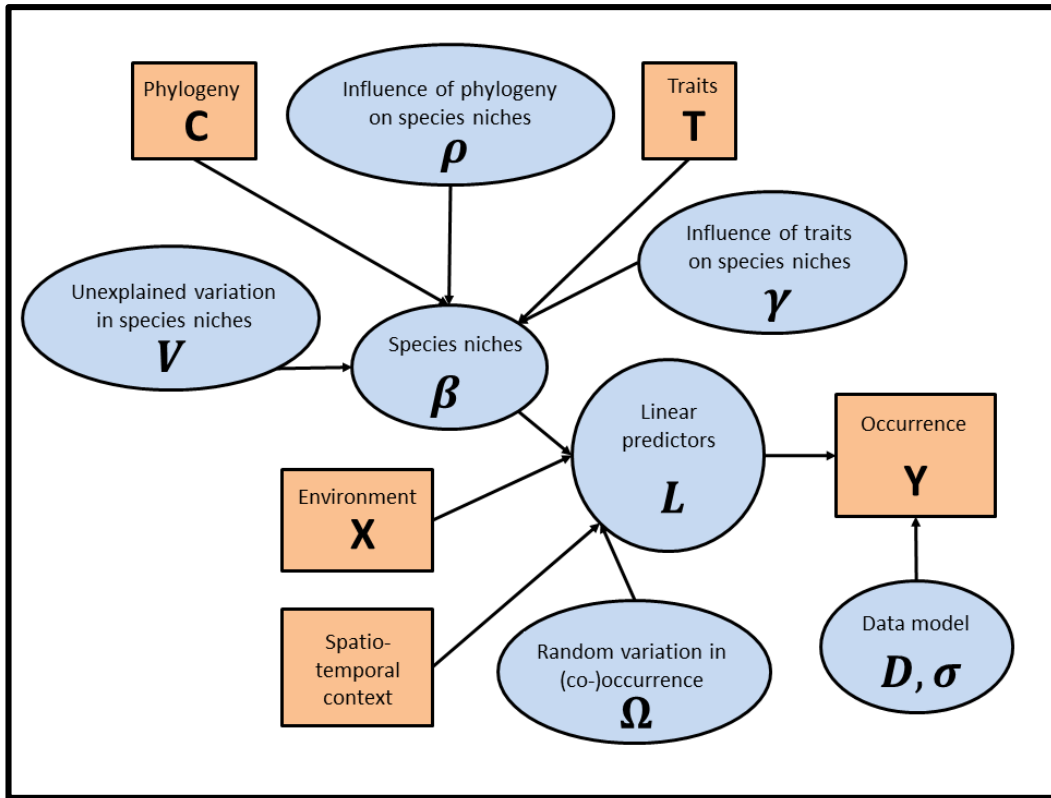
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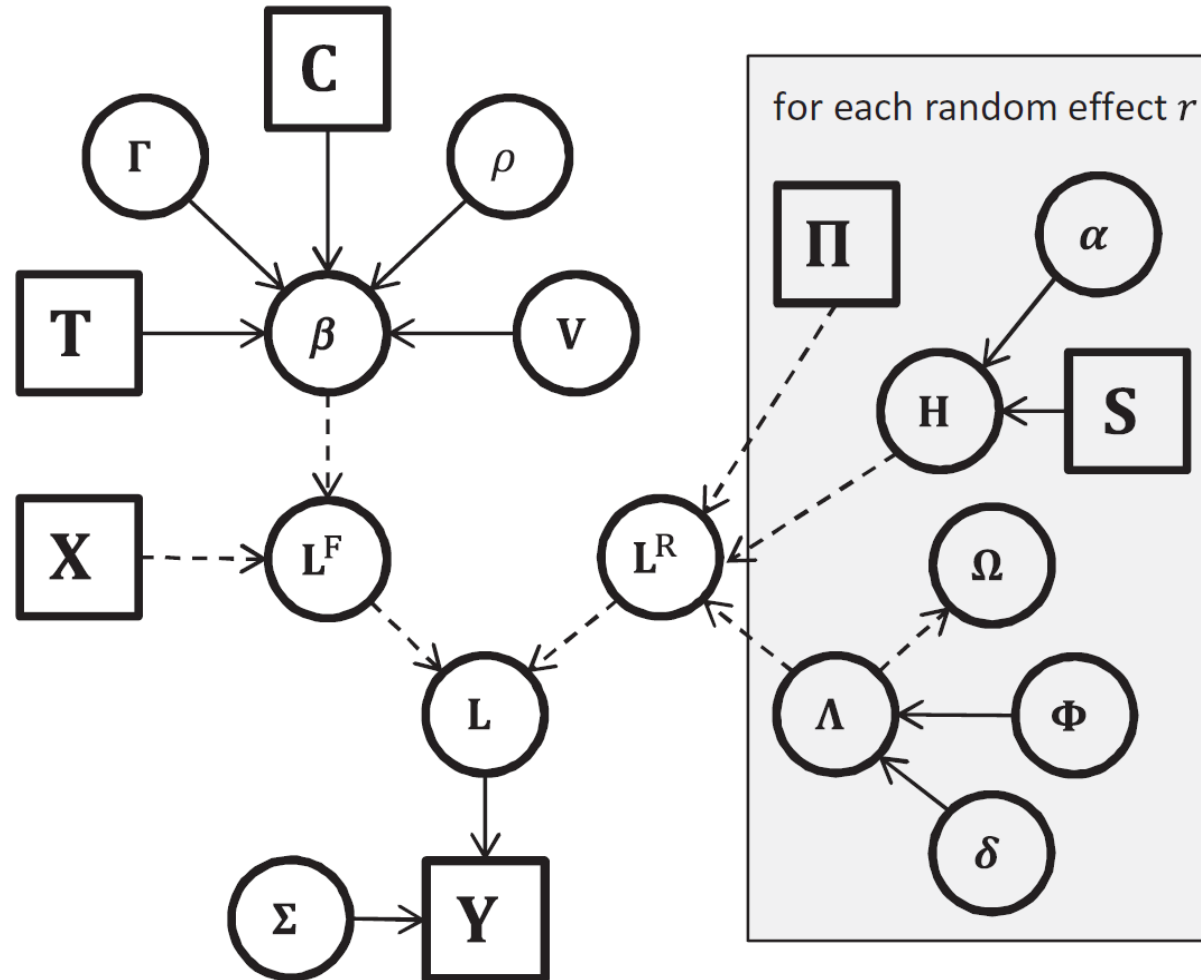
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HMSC as a directed acyclic graph



What data matrices HMSC takes as input and what are their dimensions?

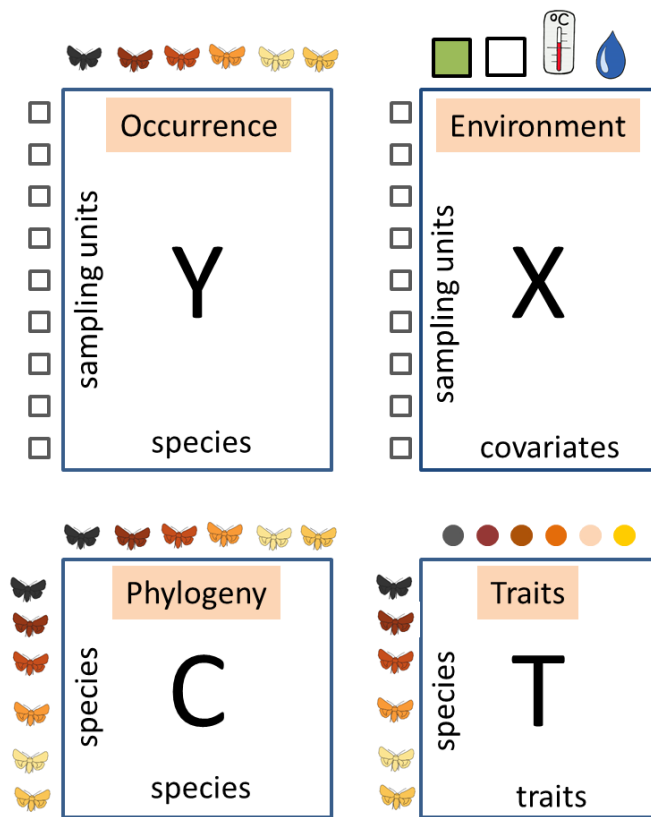
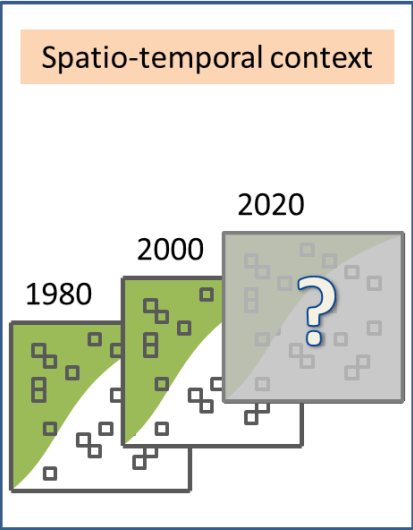


Table 4.2 *Indices and their ranges in the core HMSC model.*

Index and its range	Refers to
$i = 1, \dots, n$	Sampling unit
$j = 1, \dots, n_s$	Species
$k = 1, \dots, n_c$	Environmental covariate
$l = 1, \dots, n_t$	Species trait
$h = 1, \dots, n_f$	Latent factor
$u = 1, \dots, n_u$	Hierarchical unit
$q = 1, \dots, d$	Spatial coordinate in \mathbb{R}^d
$r = 1, \dots, n_r$	Random effect

Table 4.3 *Data matrices and their dimensions in the core HMSC model. The spatial coordinates are defined separately for each random effect r .*

Data matrix	Dimension	Refers to
Y , element y_{ij}	$n \times n_s$	Community data
X , element x_{ik}	$n \times n_c$	Environmental data
T , element t_{jl}	$n_s \times n_t$	Species trait data
C , element $c_{j,j2}$	$n_s \times n_s$	Phylogenetic data
Π , element π_{iu}	$n \times n_u$	Study design
S , element s_{uq}	$n_u \times d$	Spatial coordinates

What parameters are estimated in an HMSC model?

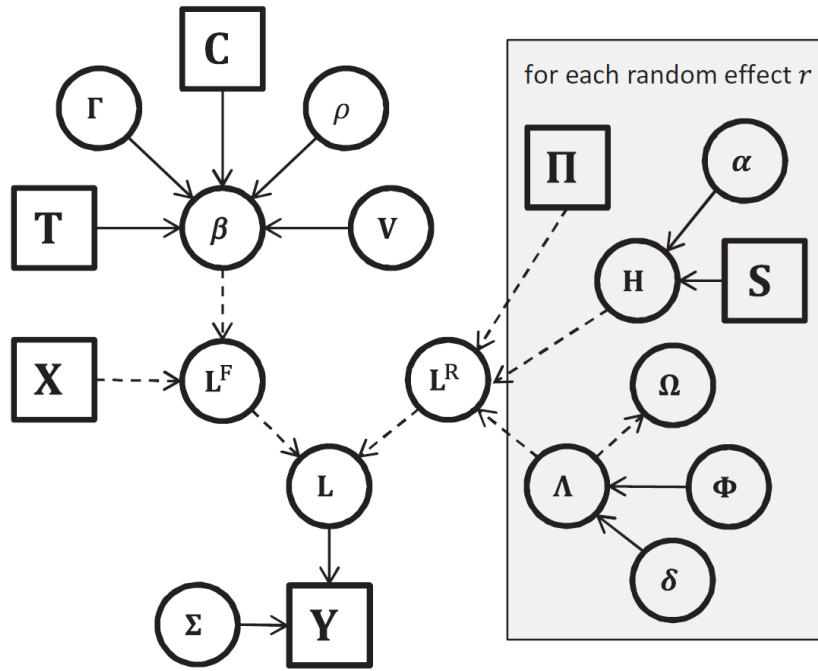


Table 4.4 *Parameters and their interpretations in the core HMSC model. The ‘Category’ column indicates whether the parameter is related to the fixed effect (F), random effect (R), or data model (D) part of HMSC. The parameters of the random effect part are defined separately for each random effect r .*

Category	Parameter	Type	Interpretation
F	\mathbf{L}^F , element L_{ij}^F	$n \times n_s$ matrix	Linear predictor of fixed effects
F	\mathbf{B} , element β_{kj}	$n_c \times n_s$ matrix	Species niches
F	\mathbf{M} , element μ_{kj}	$n_c \times n_s$ matrix	Expected species niches based on traits
F	ρ	scalar	Phylogenetic signal in species niches
F	$\mathbf{\Gamma}$, element γ_{kl}	$n_c \times n_t$ matrix	Influence of traits on niches
F	\mathbf{V} , element $V_{k_1 k_2}$	$n_c \times n_c$ matrix	Residual covariance of species niches
R	\mathbf{L}^R , element L_{ij}^R	$n \times n_s$ matrix	Linear predictor of random effects
R	\mathbf{H} , element η_{uh}	$n_u \times n_f$ matrix	Site loadings
R	$\boldsymbol{\alpha}$, element α_h	vector of length n_f	Spatial scale of site loadings
R	$\boldsymbol{\Lambda}$, element λ_{hj}	$n_f \times n_s$ matrix	Species loadings
R	$\boldsymbol{\Omega}$, element $\Omega_{j_1 j_2}$	$n_s \times n_s$ matrix	Species associations
R	$\boldsymbol{\Phi}$, element ϕ_{hj}	$n_f \times n_s$ matrix	Local shrinkage of species loadings
R	$\boldsymbol{\delta}$, element δ_l	vector of length n_f	Global shrinkage of species loadings
D	\mathbf{L} , element L_{ij}	$n \times n_s$ matrix	Linear predictor
D	$\boldsymbol{\Sigma}$, element σ_j^2	$n_s \times n_s$ diagonal matrix	Residual variance

How does HMSC link to ecological theory?

