i=point

s=species

j=replicate

Let be the occupancy status of point i for species s.

where is a group indicator.

We assume that the occupancy parameters consist of vector (species-specific random effects) and (group specific parameters). More specifically, the first vector is modeled as a standard random effect and includes the intercept term. More specifically, we assume that:

where is a diagonal matrix with elements .

**The second vector depends on group membership**. More specifically,

We could also assume a similar clustering process for the detection parameters . However, researchers are typically much more interested in how the different covariates influence occupancy rather than detection. As a result, to simplify our model, we assume a more standard random effect prior for :

where is a diagonal matrix comprised of elements

Finally, we specify the following priors:

In this model, species can belong to different occupancy groups. This model clusters species that respond similarly to environmental variables.

#------------------------------------------------

Calculating likelihood

If , then:

If at least one , then:

#-------------------------------------------

Full conditional distributions for latent variables

* For and

We will sample this joint distribution using compositional sampling. More specifically, we rely on

1. For

Notice that we only sample whenever for all j. As a result, this expression becomes:

We sample this from a Bernoulli distribution

1. For

If , then

If , then

* For

If , then:

If , then:

#--------------------------------------------------

Full conditional distributions for gammas and its priors

* For

where represents all the observations (across all I and j) for species s for which . Similarly, represents the design matrix for which

This implies that

* For

where is the number of species. This implies that

* For

Where is the number of species

This implies that

#------------------------------------------------

Full conditional distributions for

Let . Then:

where is the set of all species for which and .

This implies that

#------------------------------------------------

Full conditional distributions for and it’s prior

* For

I will denote . Therefore, we have:

This implies that

* For

Where is the number of species

* For

#---------------------------------------------------------

Full conditional distributions for other parameters

* For

where .

Where N is the number of observations.

Taking log this becomes:

To propose a new group, we note that:

Where

Taking log, this becomes:

Things that can be pre-computed are shown in yellow.

* For

This implies that