i=point

s=species

j=replicate

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

We assume that the occupancy parameters can be broken into two sub-vectors and .

The first sub-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 sub-vector has a prior that depends on group membership. More specifically,

where is a group indicator. In this model, is specified by the user. The reason for this is that the user has to decide how close the parameters have to be so that two species can be judged to belong to the same group.

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 betas

* For

Notice that I have to construct and carefully so that it adequately captures the fact that some of the slope parameters depend on group membership and others don’t.

This implies that

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

Full conditional distributions for priors of

* For

Where is the number of species assigned to group k

This implies that

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

Full conditional distributions for the prior of

* For

Where is the number of species

* For

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

Full conditional distributions for other parameters

* For

Where is the number of slope parameters in .

Taking log this becomes:

To propose a new group, we note that:

Taking log this becomes:

* For

This implies that