PLANNING

Make decisions about:

* What is the purpose of the project
* What is the goal of the project (how the output will look like)?
* What are the inputs that I need for the model?
* Classification of life stages (will use it when I make the model more realistic) (literature search)
* Model
* Assumptions of the model

R-CODING

* Generate a dummy community at year 0 with 4 species and 4 life stages (seed, seedling, sapling, adult) each species has 100 individuals in each life stage
* Generate array of matrices of parameters for each species
* Matrix multiplication “%\*%”
* Generate a function that look through the output and report a community structure at a specific time

“BELLS & WHISTLES”

* Make it more realistic
* More detail when I get here

**DETAIL**

PLANNING

Purpose of the project: To develop a model projecting the forest community structure in the future

Output that I am aiming for: an array with matrices of populations structure of different species as components

For example: If the community has s species, the output will be an array with s matrices, each matrix has t rows (t = time (year)) with four columns reporting number of individuals in each stage (seed, seedling, sapling, adult). Below is the first component of the array: the population structure of species 1

[ , , 1]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | seed | seedling | sapling | adult |
| 1 | Ns11 | Nsl11 | Nsa11 | Na11 |
| 2 | Ns12 | Nsl12 | Nsa12 | Na12 |
| … | … | … | … | … |
| T | Ns1t | Nsl1t | Nsa1t | Na1t |

Ns11 = Number of seeds of species 1 at year 1

Nsl12 = Number of seedling of species 1 at year 2

Inputs for the model

1. Matrix of community structure at time 0, columns are life stages and rows are species

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | seed | seedling | sapling | adult |
| 1 | Ns10 | Nsl10 | Nsa10 | Na10 |
| 2 | Ns20 | Nsl20 | Nsa20 | Na20 |
| … | … | … | … | … |
| s | Nss0 | Nsls0 | Nsat0 | Nat0 |

1. Matrix of mortality rates and transition rates of each species in the community

Seed : germination rate (Gs) \*\*(1-Gs = mortality rate(Ms))

Seedling : mortality (Msl), transition rate (Gsl) \*\*

Sapling : mortality (Msa), transition rate (Gsa)

Adult : mortality (Ma), Reproduction rate (Ra), Maximum size

Ns1 = Na0\*Ra

Nsl1 = Nsl0 - Nsl0\*Msl + Ns0\*Gs

Nsa1 = Nsa0 – Nsa0\*Msa – Nsa0\*Gsa + Nsl0\*Gsl

Na1 = Na0 – Na0\*Ma + Nsa\*Gsa

The matrix will have 7 columns for 7 parameters and n rows for n species

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Ra | Gs | Msl | Gsl | Msa | Gsa | Ma |
| sp1 | Ra1 | Gs1 | Msl1 | Gls1 | Msa1 | Gsa1 | Ma1 |
| Sp2 | .. | .. | .. | .. | .. | .. | .. |
| spn | Ran | Gsn | Msln | Gsln | Msan | Gsan | Man |

1. Time (t)

Model

Community at time t+1 = community at time t \* mortality&transition rate matrix

Assumptions

There is no dormancy

Only adult produces seeds

R-CODING

1. Generate dummy community matrix at time 0 with 4 species as rows and 4 life stages as columns each species has 100 individuals in each life stages

t0.com = matrix(data=100,nrow=4, ncol=4)

1. Generate dummy mortality and transition rate matrix with 7 rates as columns (Ra, Gs, Msl, Gsl, Msa, Gsa, Ma) and 4 species as rows (4x7)

Ra

species produce between 100 seeds to 1000 seeds/tree

sample(100:1000, 4, replace=TRUE)

Msl, Msa, Ma (mortality rates)

As survival curve of trees is type III then I expect that

1-Gs (Ms rate) >>>Msl>>Msa>Ma

Msl = rnorm(4, mean=0.7, sd=0.09) #~ 70 seedlings out of 100 die in year1

Msa = rnorm(4, mean=0.04, sd=0.009) #~ 4 saplings out of 100 die in year1

Ma = rnorm(4, mean=0.0005, sd=0.00001) #~ 0.05 trees out of 100 die in year1

Gs, Gsl, Gsa (transition rates)

Gs = rnorm(4,mean=0.2, sd=0.1) #20% of seeds survives to seedling stage

Gsl and Gsa

I think it will take a long time for transitioning from seedling to sapling and sapling to adult, it may require many years--- therefore, I expect the rate to be very low

Gsl = rnorm(4, mean=0.004, sd=0.0009) #0.4 seedlings turn into sapling in first year

Gsa = rnorm(4, mean=0.002, sd=0.0001) #0.2 saplings turn into adult in first year

1. Create function that takes given transition rate of each species and turn it into a 4x4 matrix (transition matrix)

|  |  |  |  |
| --- | --- | --- | --- |
| 0 | Gs | 0 | 0 |
| 0 | 1-Msl | Gsl | 0 |
| 0 | 0 | 1-Msa-Gsa | Gsa |
| Ra | 0 | 0 | 1-Ma |

1. Create the function that takes the 4x7 matrix containing mortality and transition rates and produce an array containing transition matrix (4x4) of each species
2. Create the function that takes community matrix, 4x4 matrix of mortality&transition rates and time (t), then computes community structure of each year and collect them into an array (each member of array is a community structure of each year)

matrix multiplication = %\*%

1. Plot graph