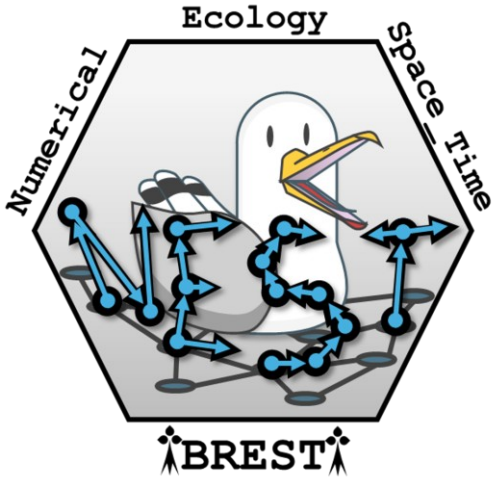
Network Tools for Ecology

David Cunillera-Montcusí
david.cunillera@dcm.cat



ISblue The interdisciplinary graduate school for the blue planet

Brest 12/05/2025

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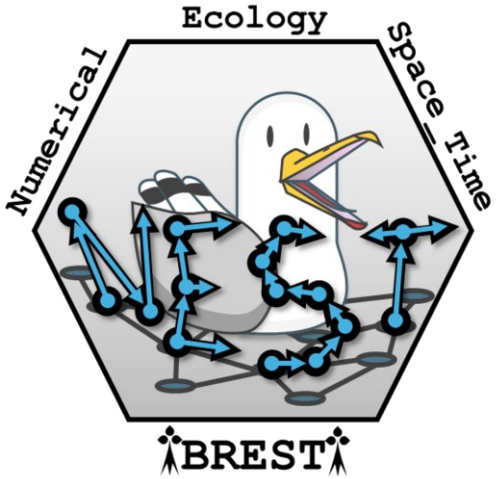


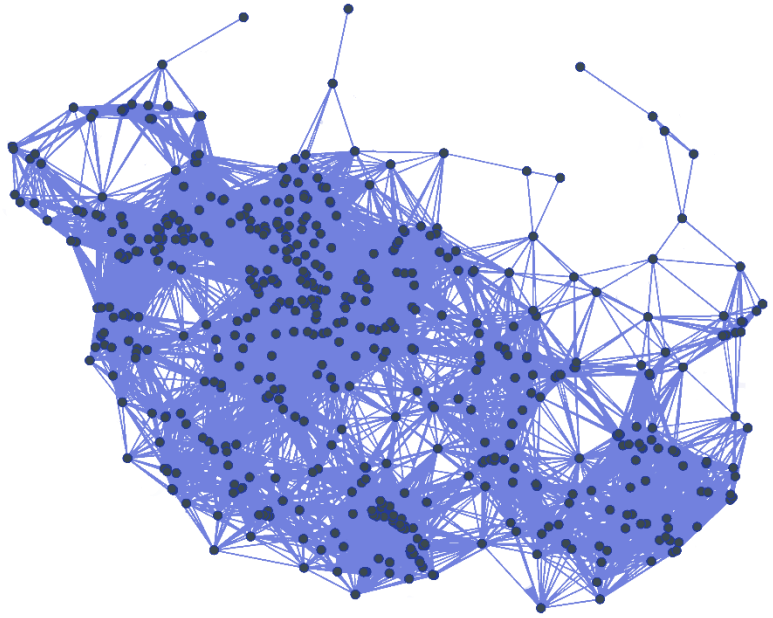
ISblue The interdisciplinary graduate school for the blue planet

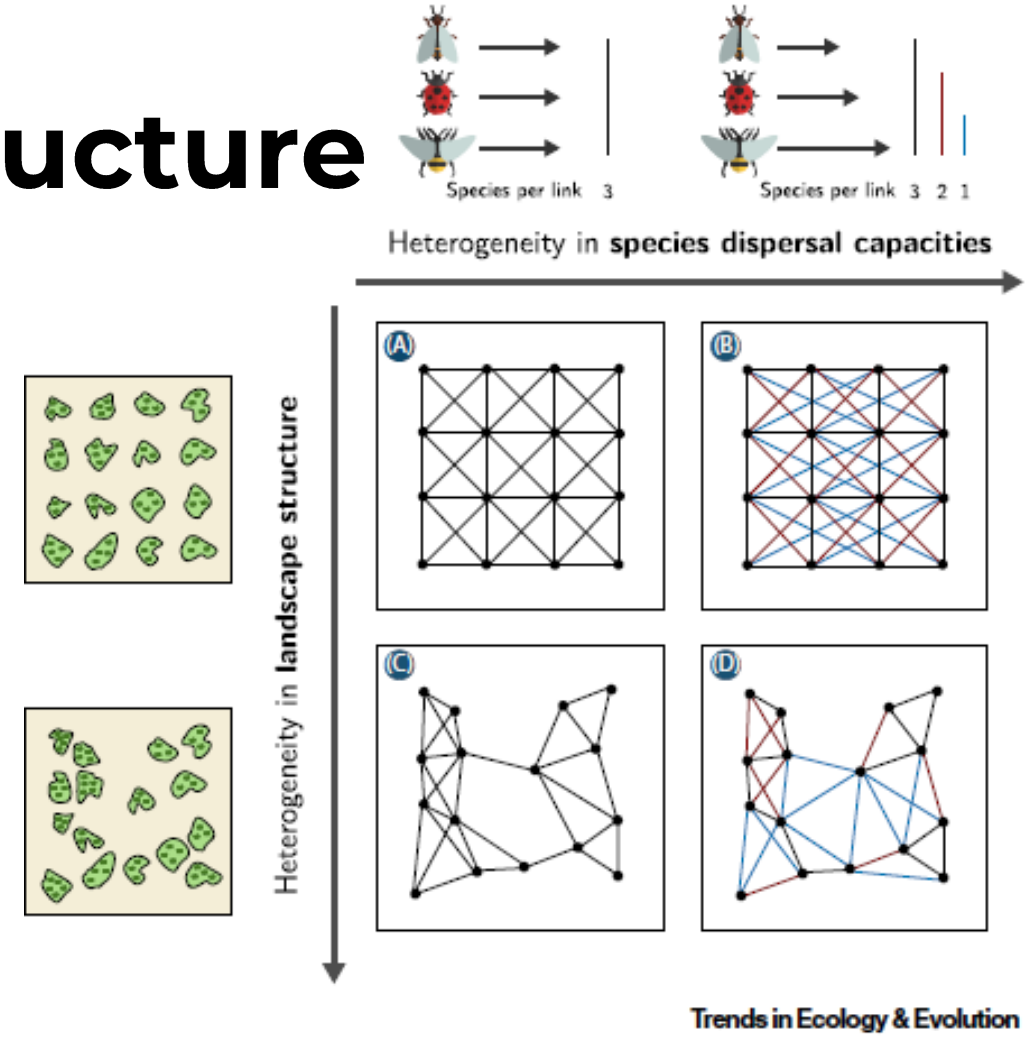
- First session (10:00-11:00)
  - Introduction to networks
  - Spatial networks and where to find them
  - R time through network examples
- Second session (11:30-12:30)
  - Connecting network structure with diversity
  - Coalescent runs and habitat loss

Brest 12/05/2025

Connecting network structure with diversity

Network structure





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Connecting network structure with diversity

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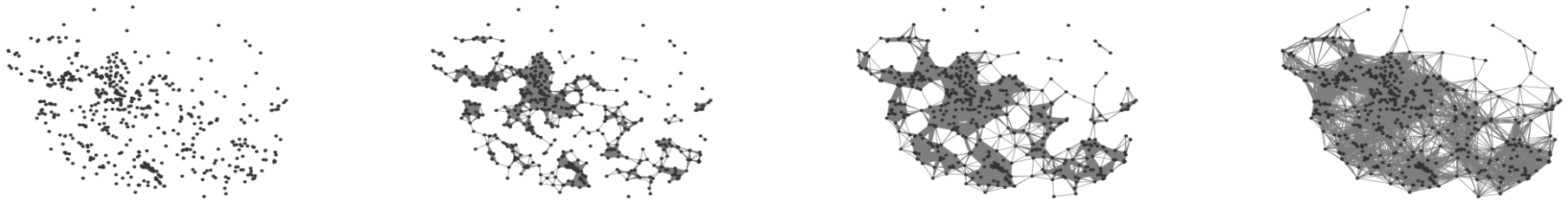

Dispersal rate

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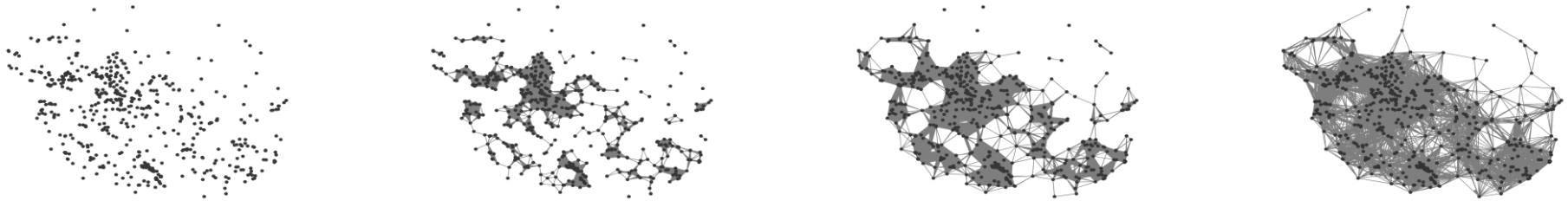
Connecting network structure with diversity

Biotic interactions
Abiotic filtering
Dispersal

Biotic interactions
Abiotic filtering
Dispersal

Biotic interactions
Abiotic filtering
Dispersal



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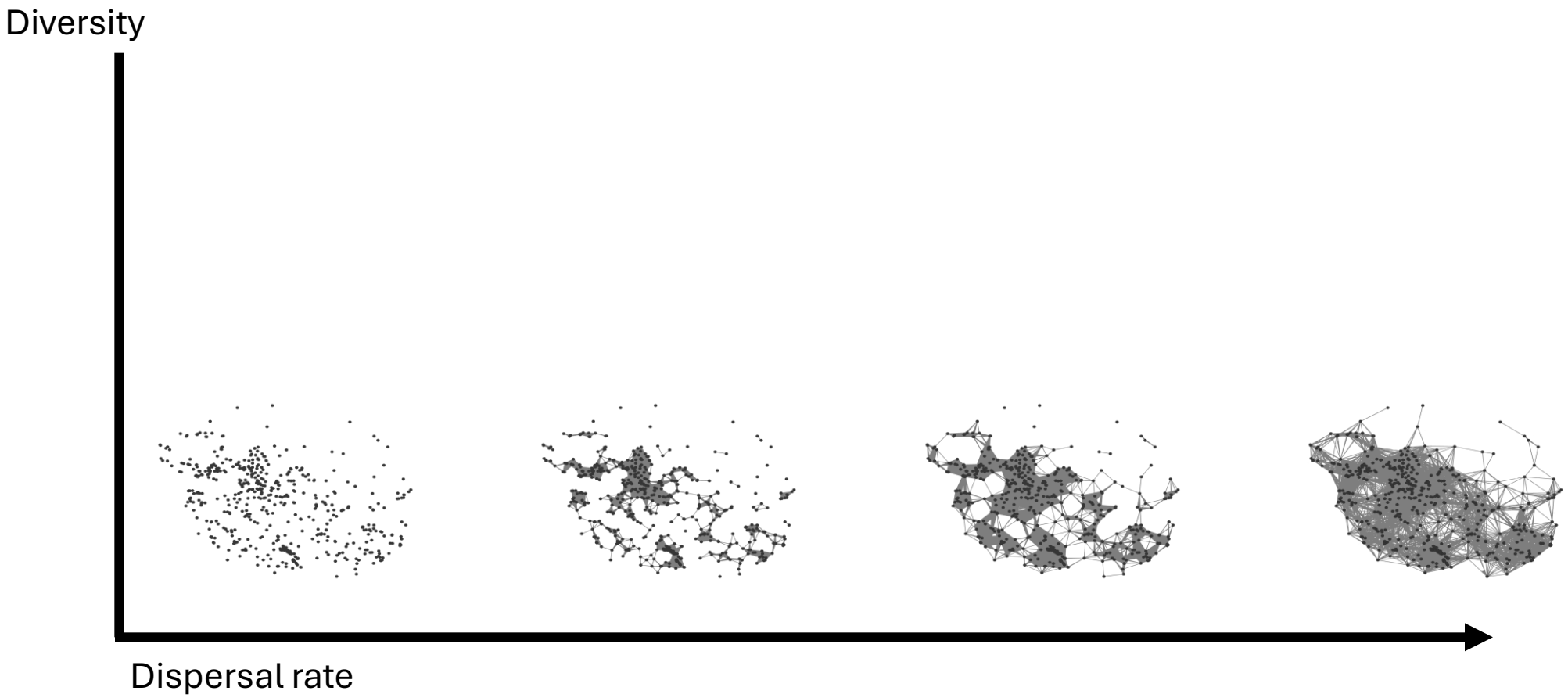

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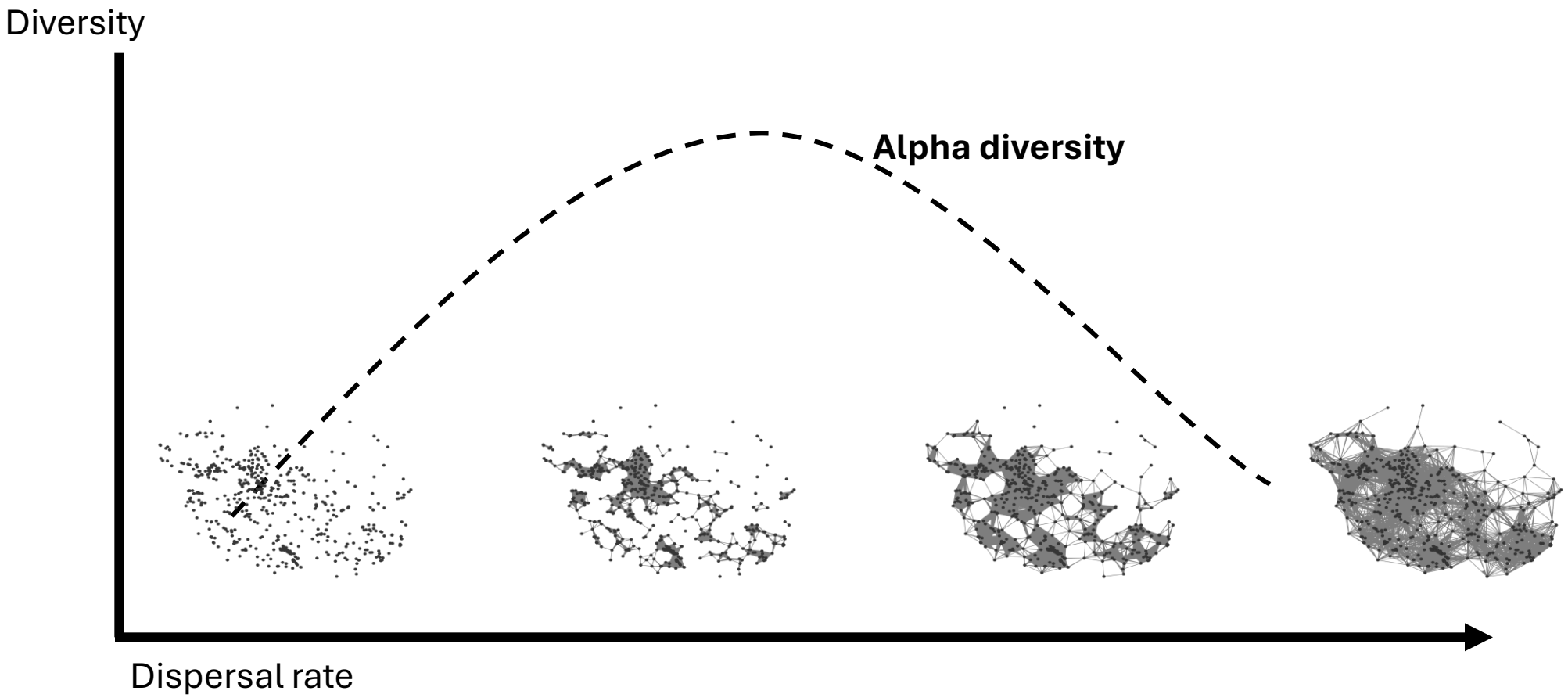

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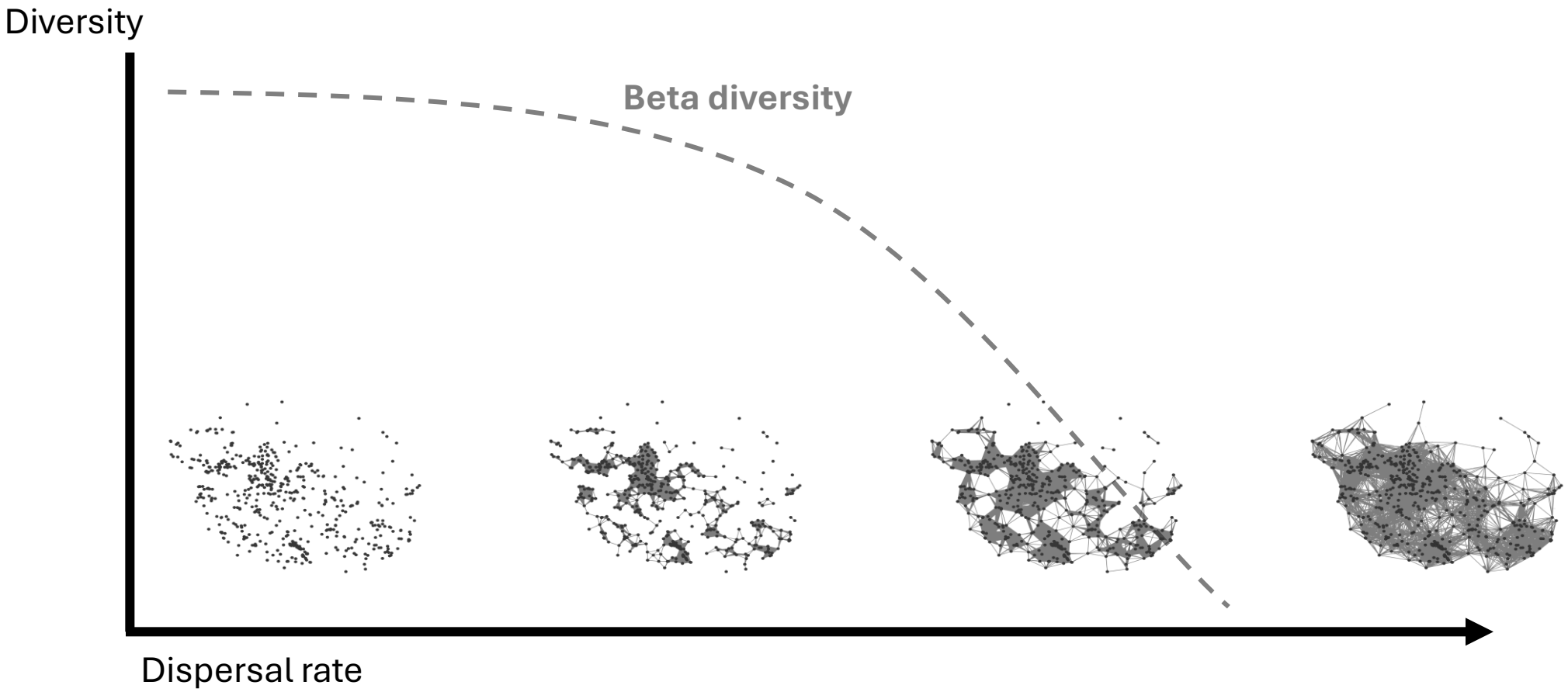

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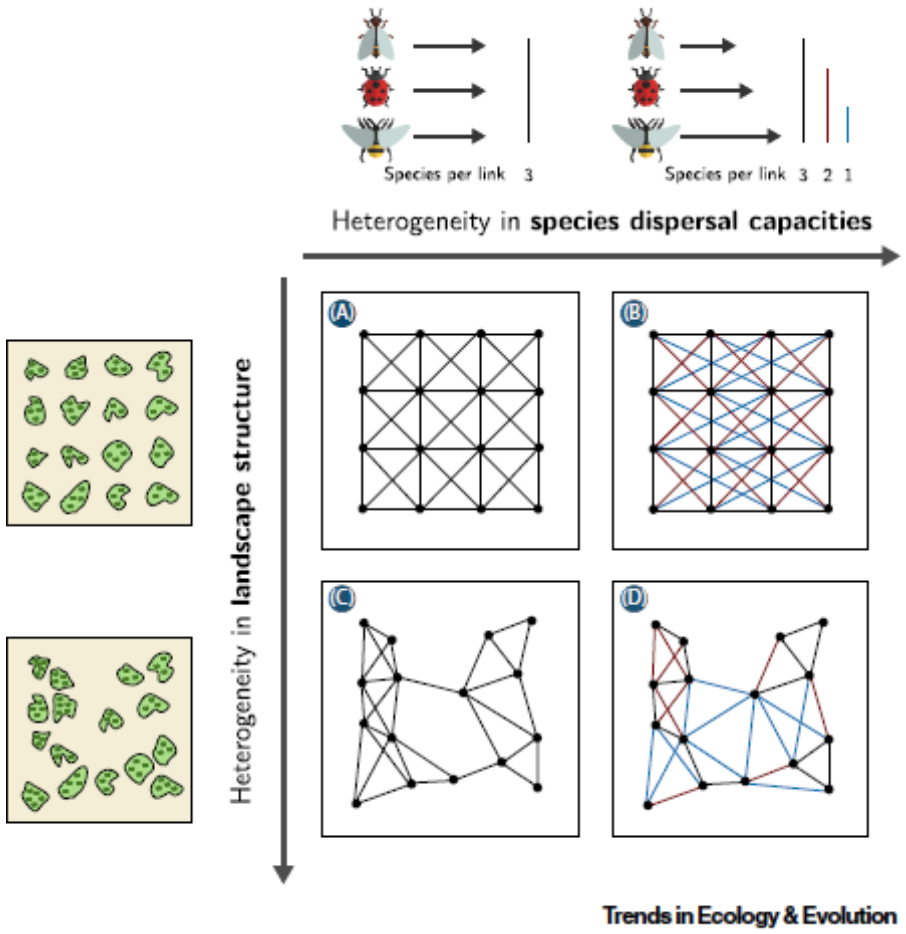

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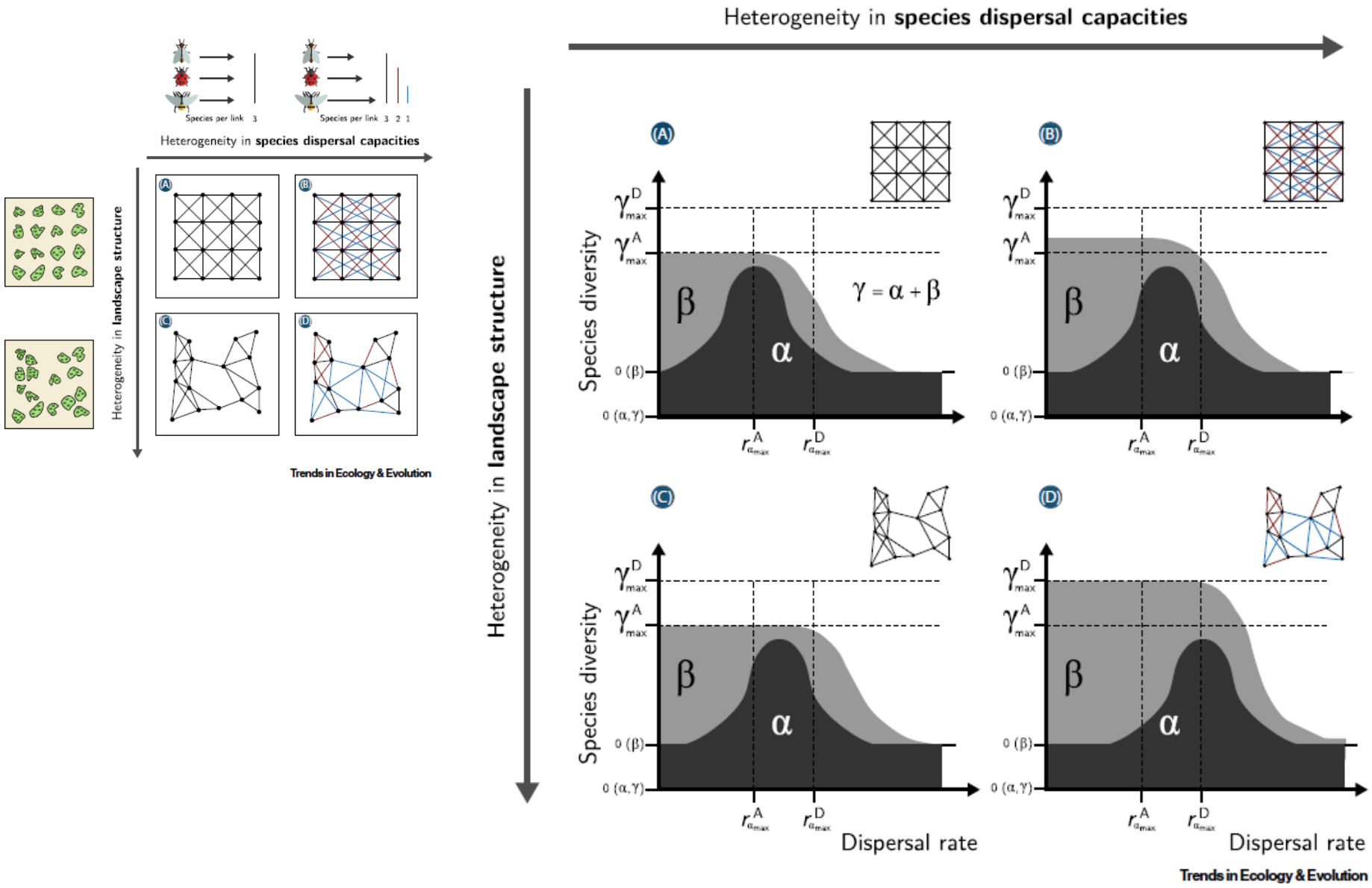

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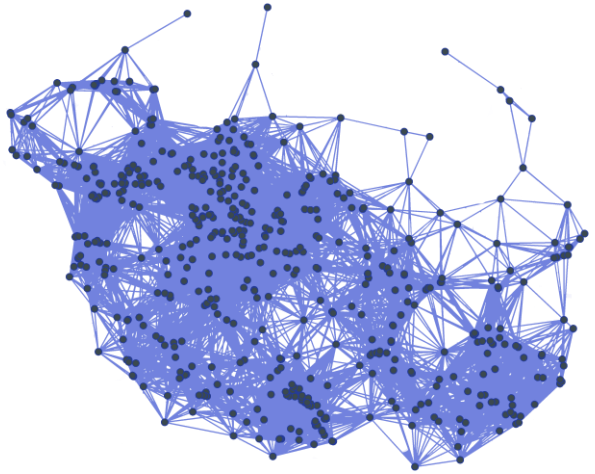
Connecting network structure with diversity

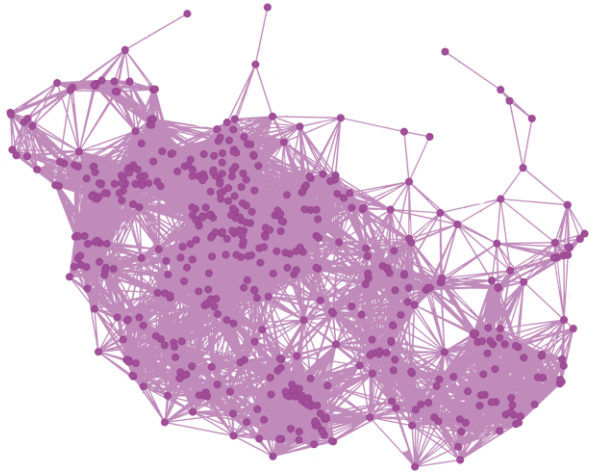
Spatial network

↓

In silico

Metacommunity models

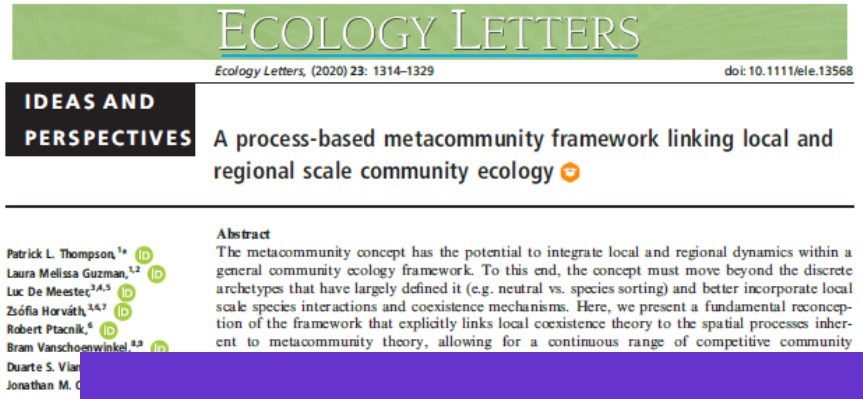




Connecting network structure with diversity

In silico

Metacommunity models



ECOLOGY LETTERS

Ecology Letters, (2020) 23: 1314–1329 doi: 10.1111/ele.13568

IDEAS AND PERSPECTIVES

A process-based metacommunity framework linking local and regional scale community ecology

Patrick L. Thompson, Laura Melissa Guzman, Luc De Meester, Zsófia Horváth, Robert Ptacnik, Bram Vanschoenwinkel, Duarte S. Vian, Jonathan M. C

Abstract

The metacommunity concept has the potential to integrate local and regional dynamics within a general community ecology framework. To this end, the concept must move beyond the discrete archetypes that have largely defined it (e.g. neutral vs. species sorting) and better incorporate local scale species interactions and coexistence mechanisms. Here, we present a fundamental reconception of the framework that explicitly links local coexistence theory to the spatial processes inherent to metacommunity theory, allowing for a continuous range of competitive community

ECOGRAPHY

Research

Metacommunity resilience against simulated gradients of wildfire: disturbance intensity and species dispersal ability determine landscape recover capacity

David Cunillera-Montcusí, Ana Inés Borthagaray, Dani Boix, Stéphanie Gascón, Jordi Sala, Irene Tornero, Xavier D. Quintana and Matías Arim

RESEARCH ARTICLE

Methods in Ecology and Evolution

ecolottery: Simulating and assessing community assembly with environmental filtering and neutral dynamics in R

François Munoz[1] | Matthias Grenié[2] | Pierre Denelle[2] | Adrien Taudière[2] | Fabien Laroche[2,3] | Caroline Tucker[2,4] | Cyrille Violle[2]

Received: 19 April 2024 | Accepted: 4 March 2025

DOI: 10.1111/1365-2656.70033

RESEARCH ARTICLE

Journal of Animal Ecology

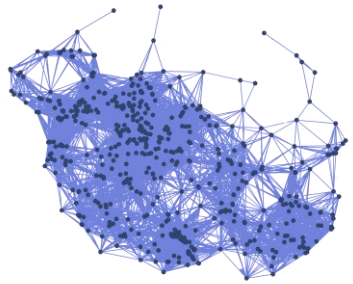
Inferring riverscape dispersal processes from fish biodiversity patterns

Ana I. Borthagaray[1,2] | Franco Teixeira de Mello[1] | Matías Arim[1,2]

Connecting network structure with diversity

Observed landscape structure

Spatial location of habitats



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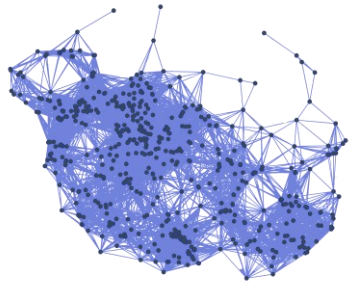
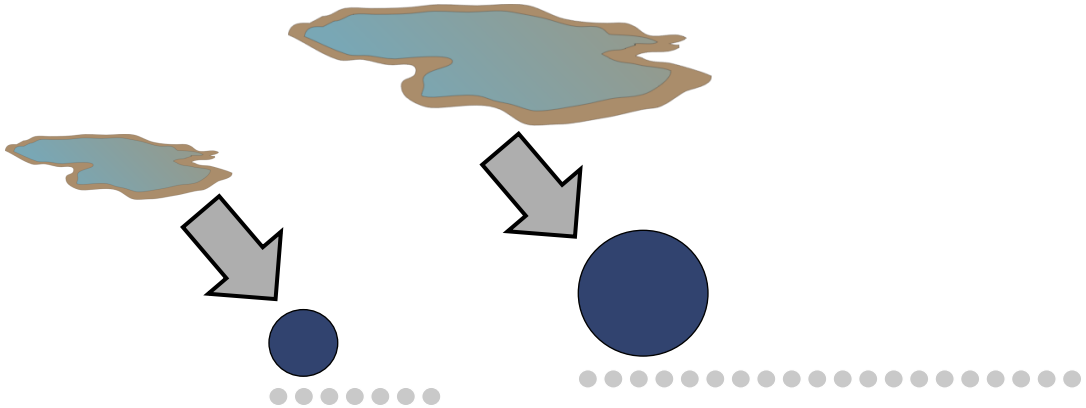


Habitat size

Local community size (**J**) is a power function of Area ($J \sim Area^b$)



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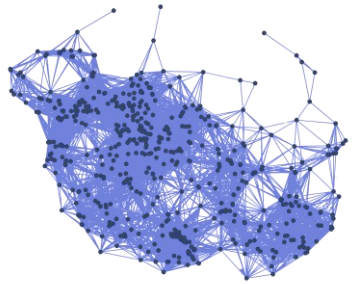

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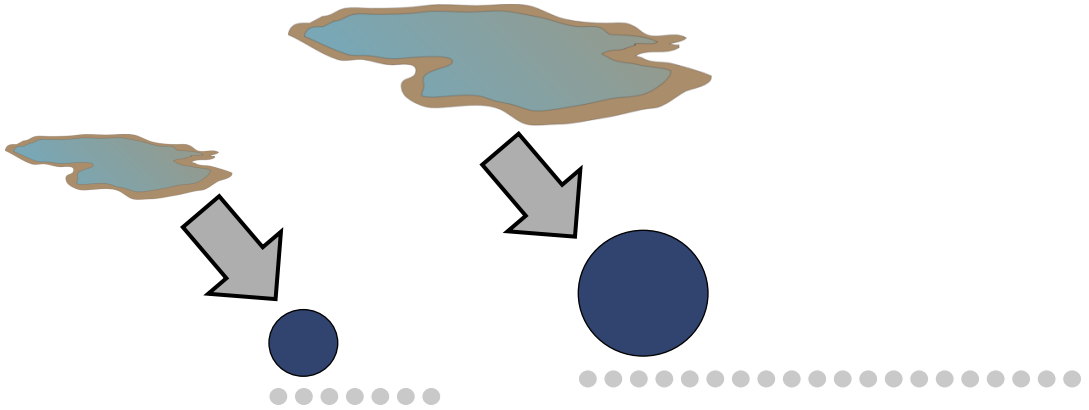
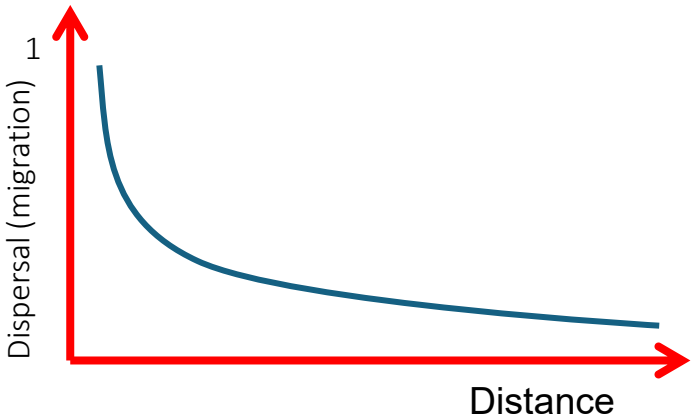
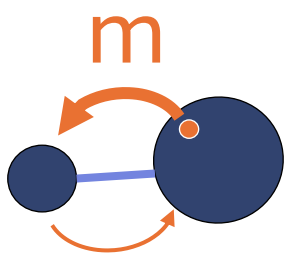
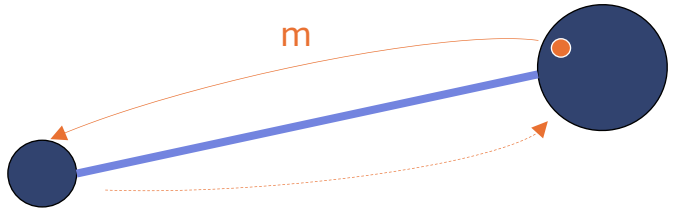


Dispersal

Dispersal is function of the distance between local communities (dispersal Kernel).







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Connecting network structure with diversity

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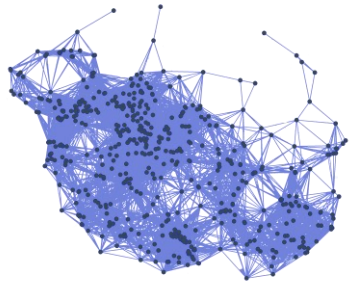

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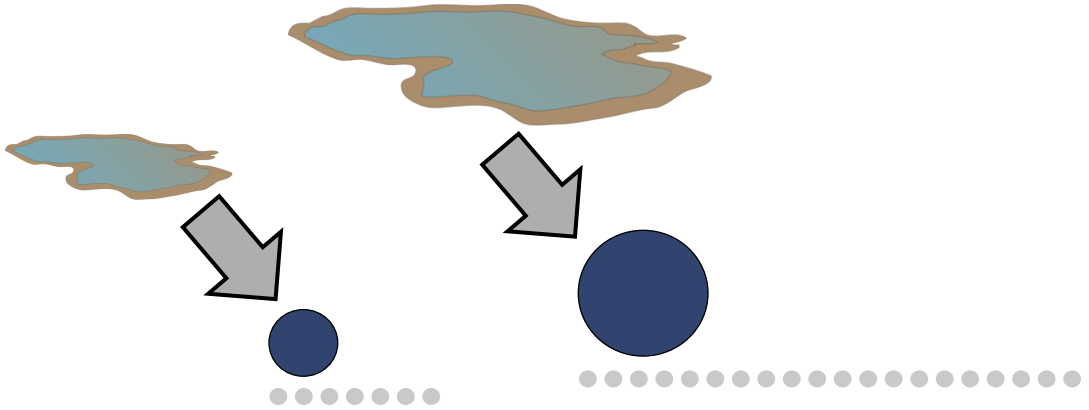

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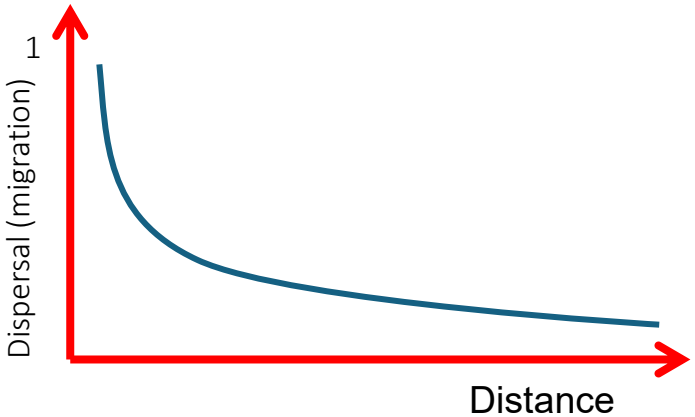

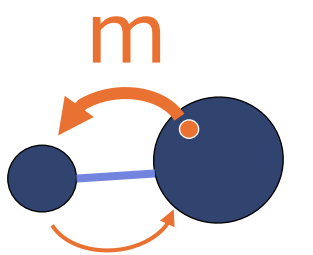

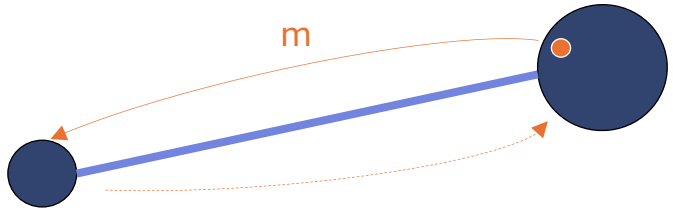

The "**weight**" of links is determined by the expected dispersal, times the size of the source community (Hanskii 1999)

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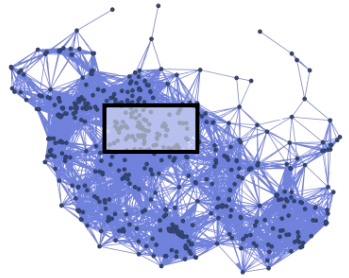
Connecting network structure with diversity



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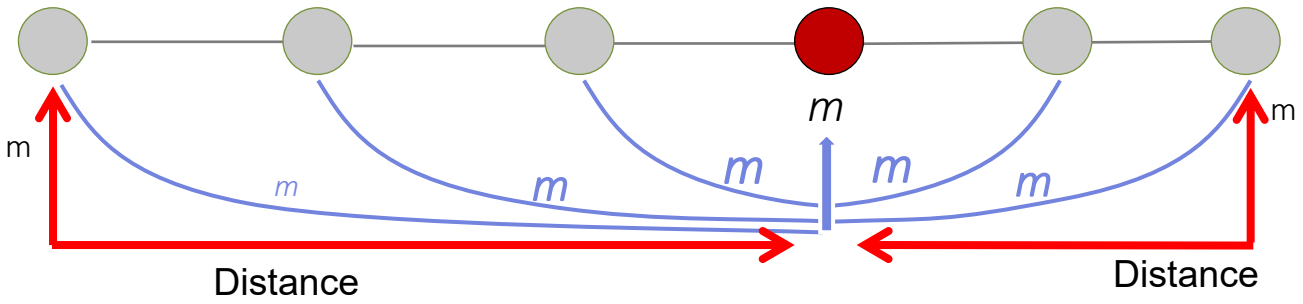

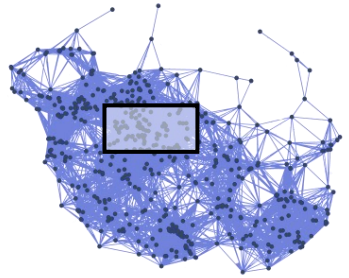

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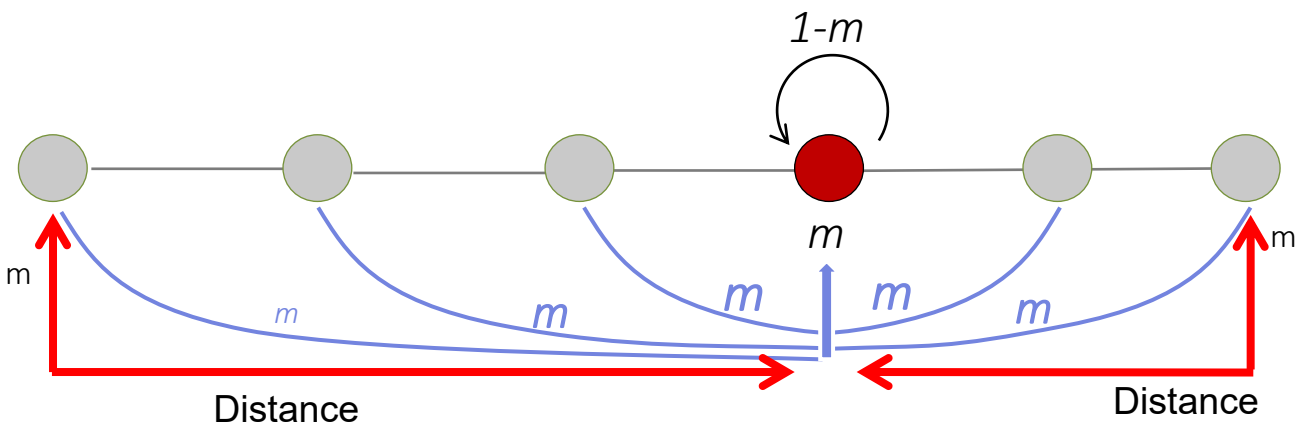

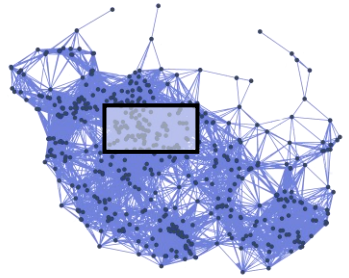

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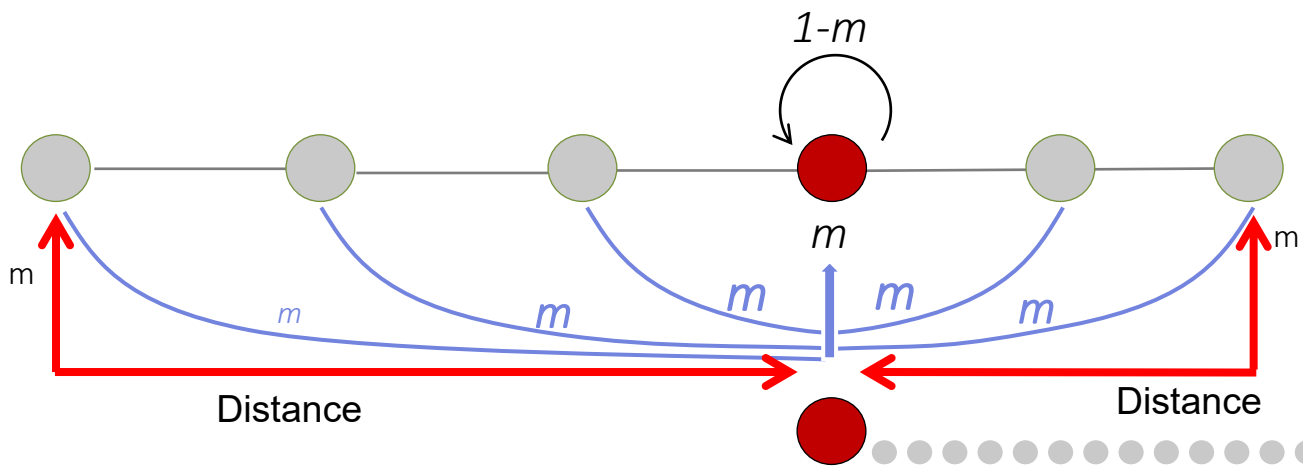

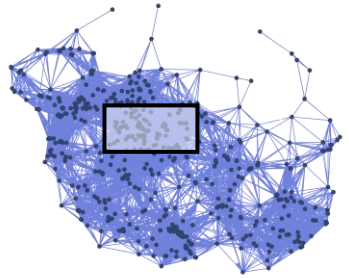

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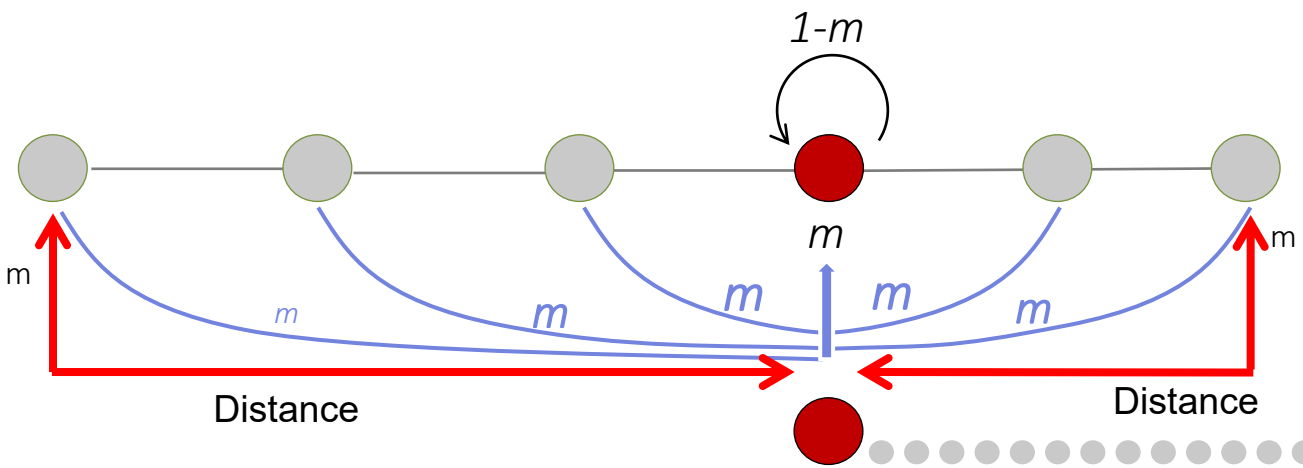

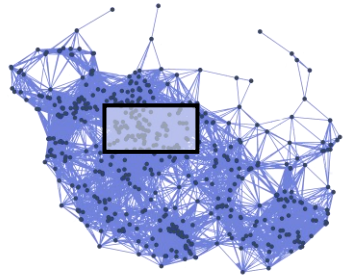

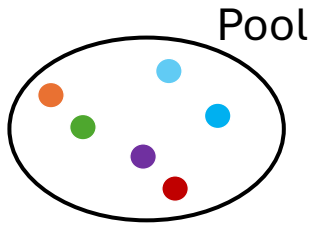

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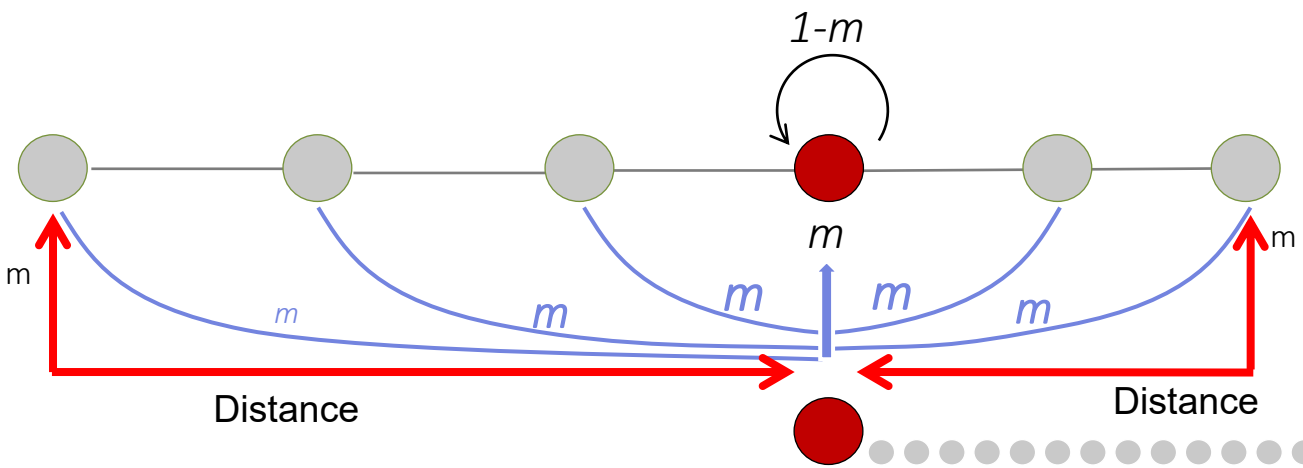

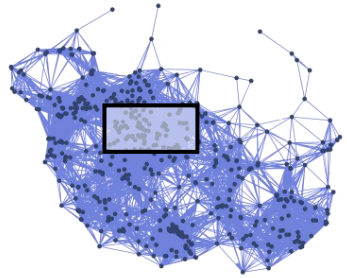

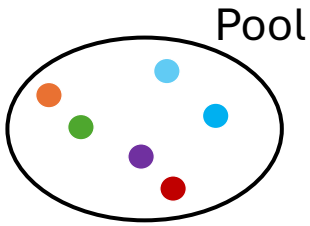

t=0 1 individual in each pond from the pool

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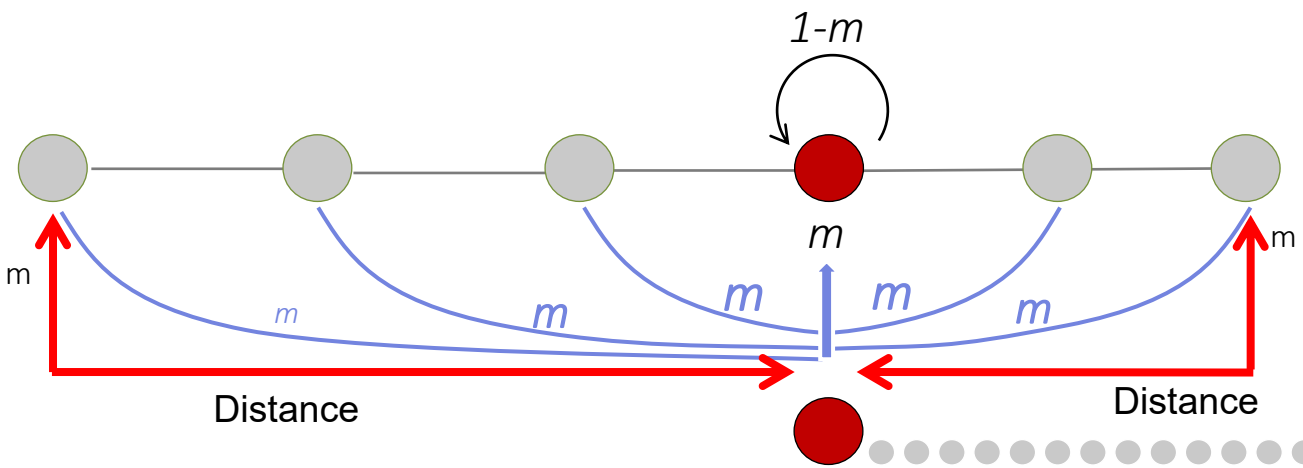

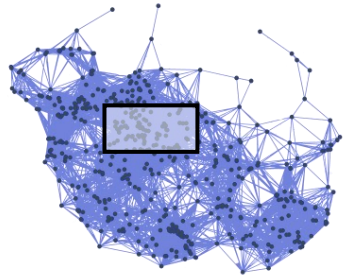

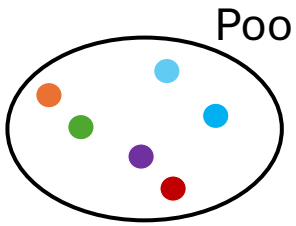

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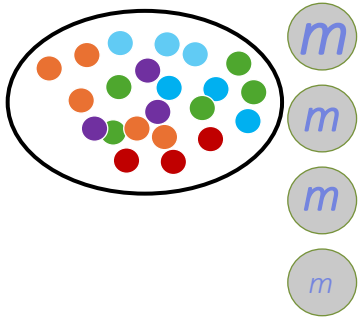
Neighboring pool



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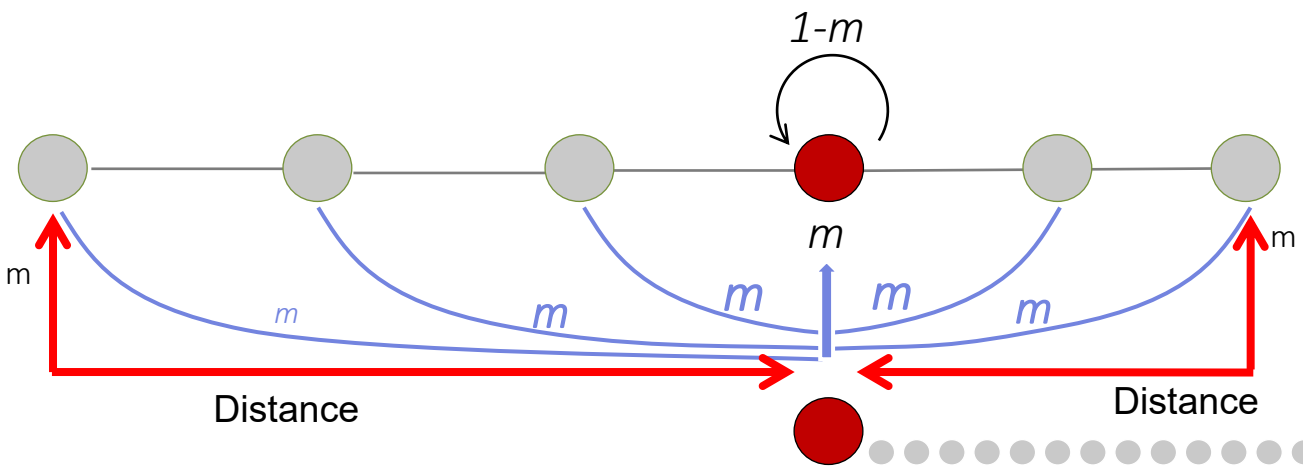
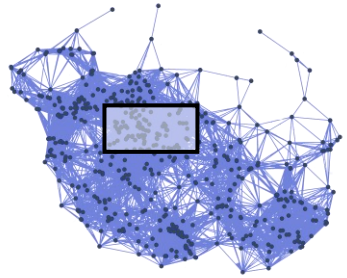
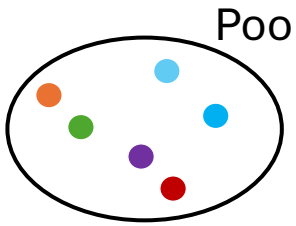
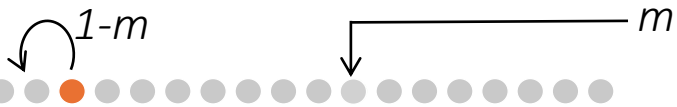


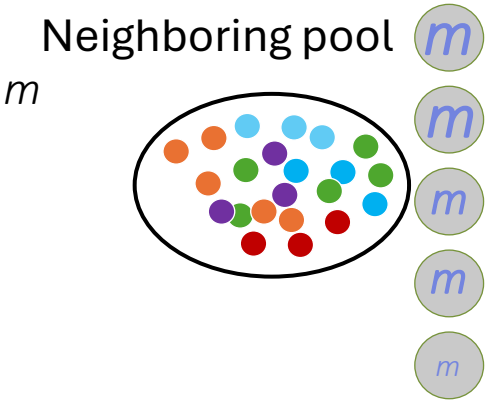




t=0 1 individual in each pond from the pool

t=1





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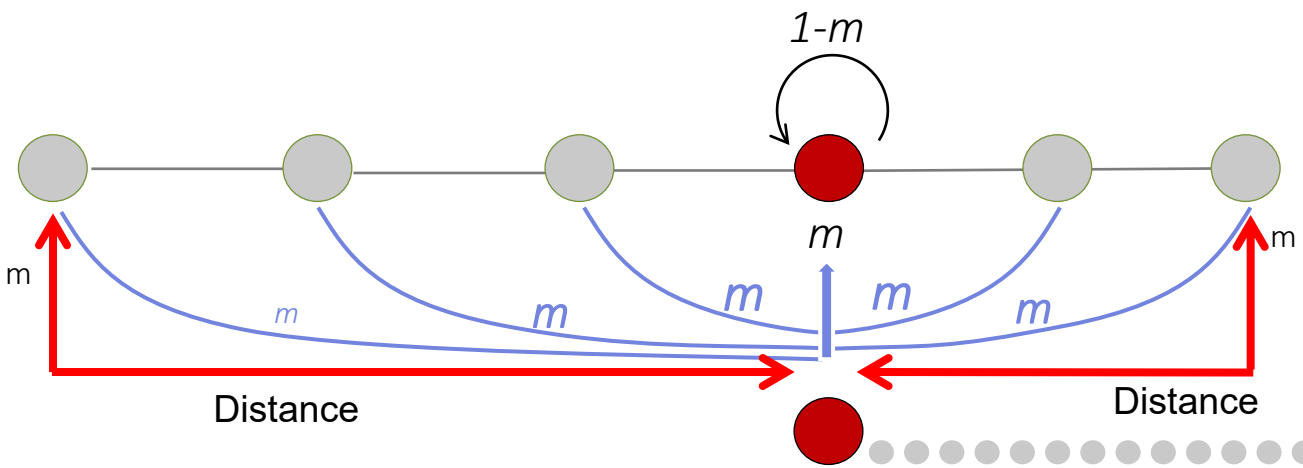
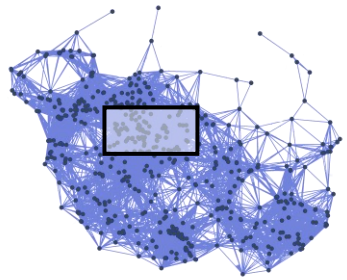
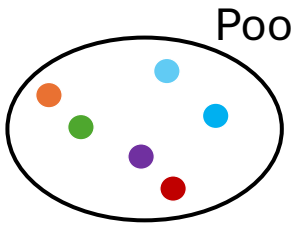
Connecting network structure with diversity







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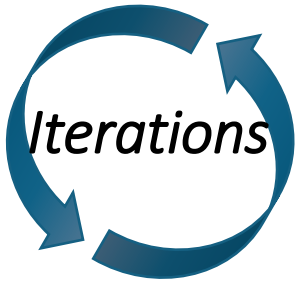

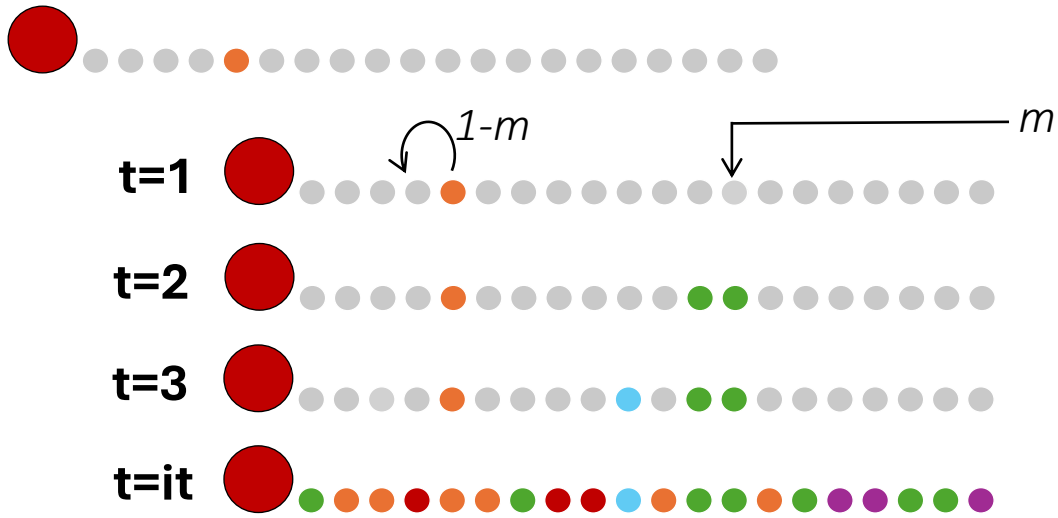

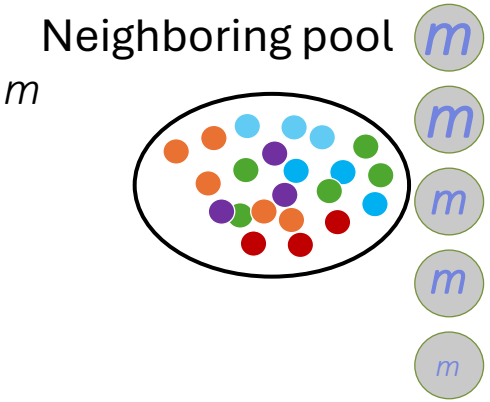

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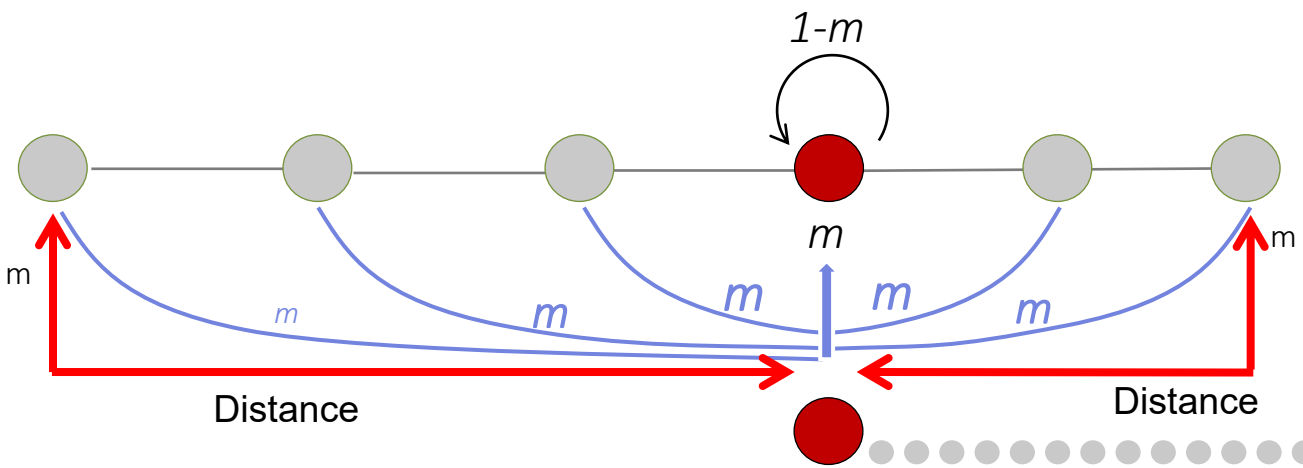
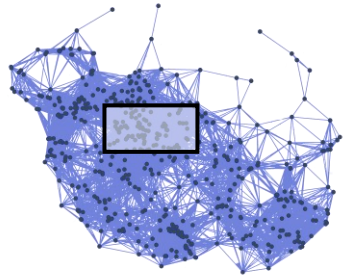
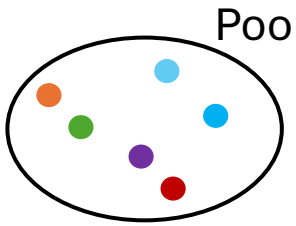
Connecting network structure with diversity







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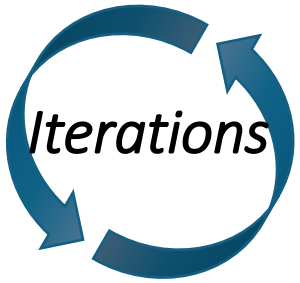
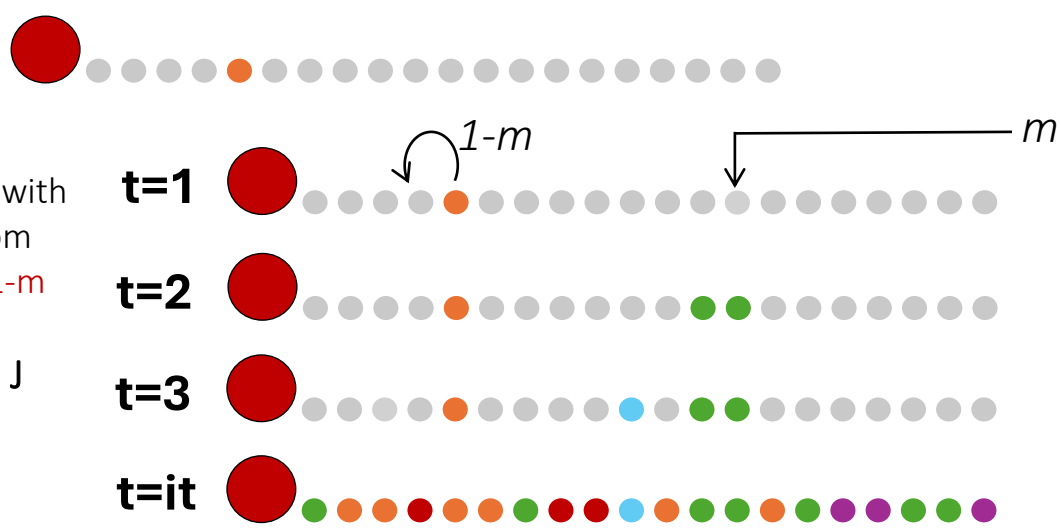
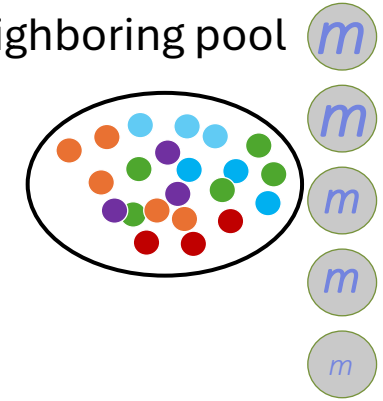


Individuals are incorporated with probability m=f(distance) from neighbor communities and 1-m from the same community.

Until community size is filled J





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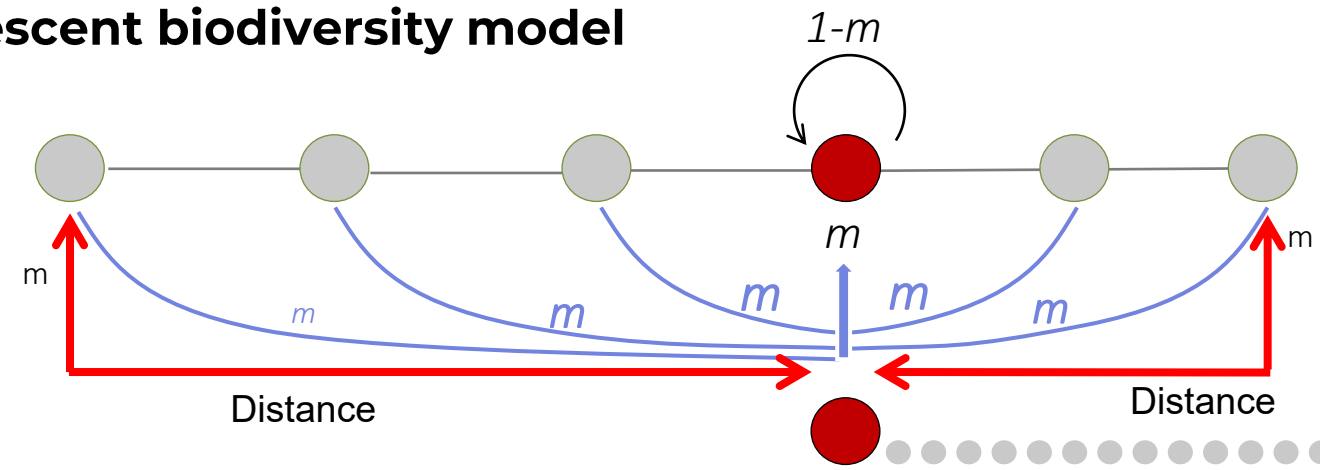
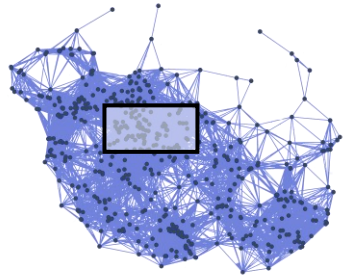
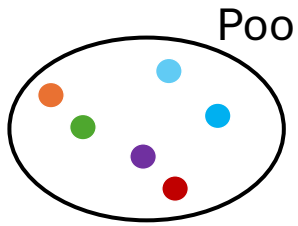
Connecting network structure with diversity

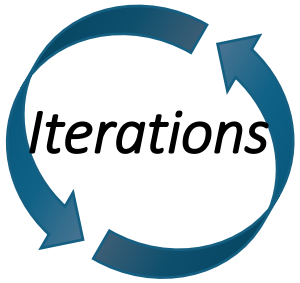
Coalescent biodiversity model







t=0 1 individual in each pond from the pool



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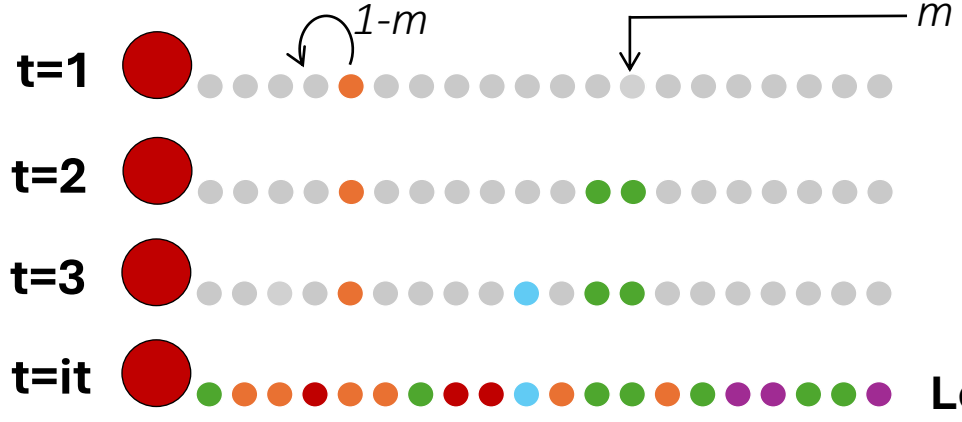

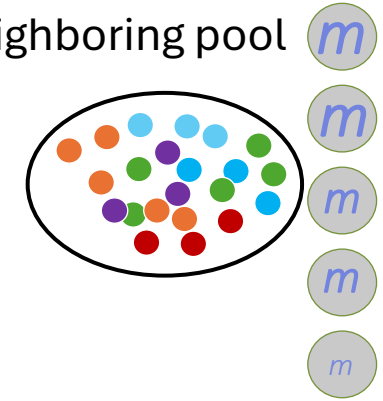

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Connecting network structure with diversity

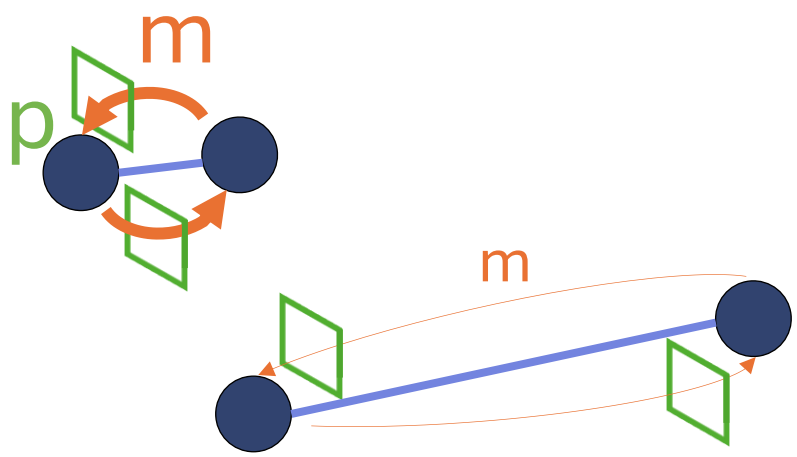
Coalescent biodiversity model

Local conditions

Penalty imposed to species that **diminishes their probability of establishment.**

Habitats with determined conditions (e.g. polluted) may impose a greater environmental filter for sensitive species.

Penalty imposed to species & habitats. If all species & habitats have the same penalty, there is no filter.



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Connecting network structure with diversity

Coalescent built
Community fully determined by the landscape structure (habitat position + size).
It summarizes regional structure **from a source-sink** point of view.

***Lottery biodiversity model**
Will "exaggerate" the coalescent pattern and bring "extinction + colonization" dynamics.
Adds a temporal component. The more iterations the model is run the more submitted to drift communities are.

Network&Diversity_Part3.R

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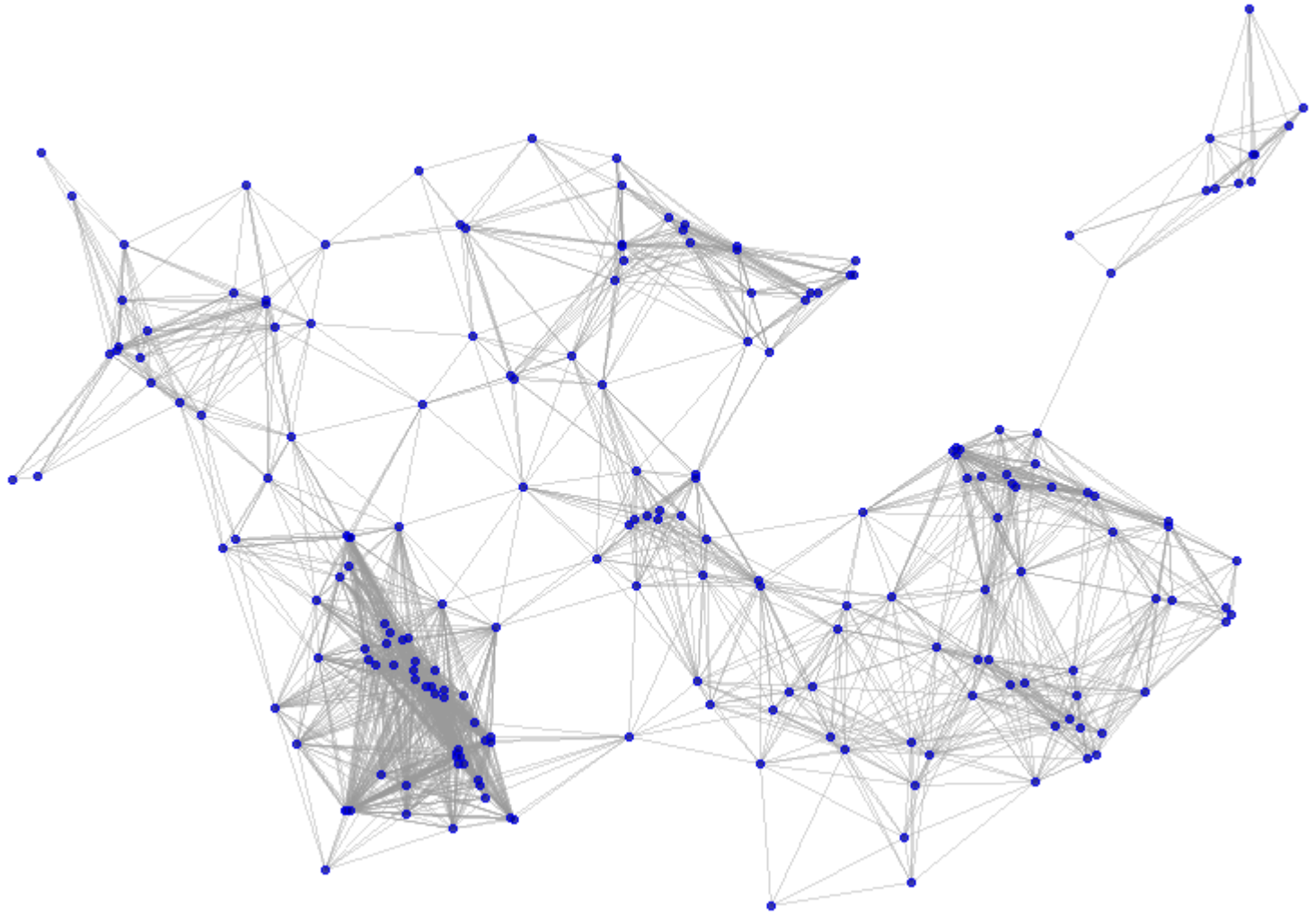

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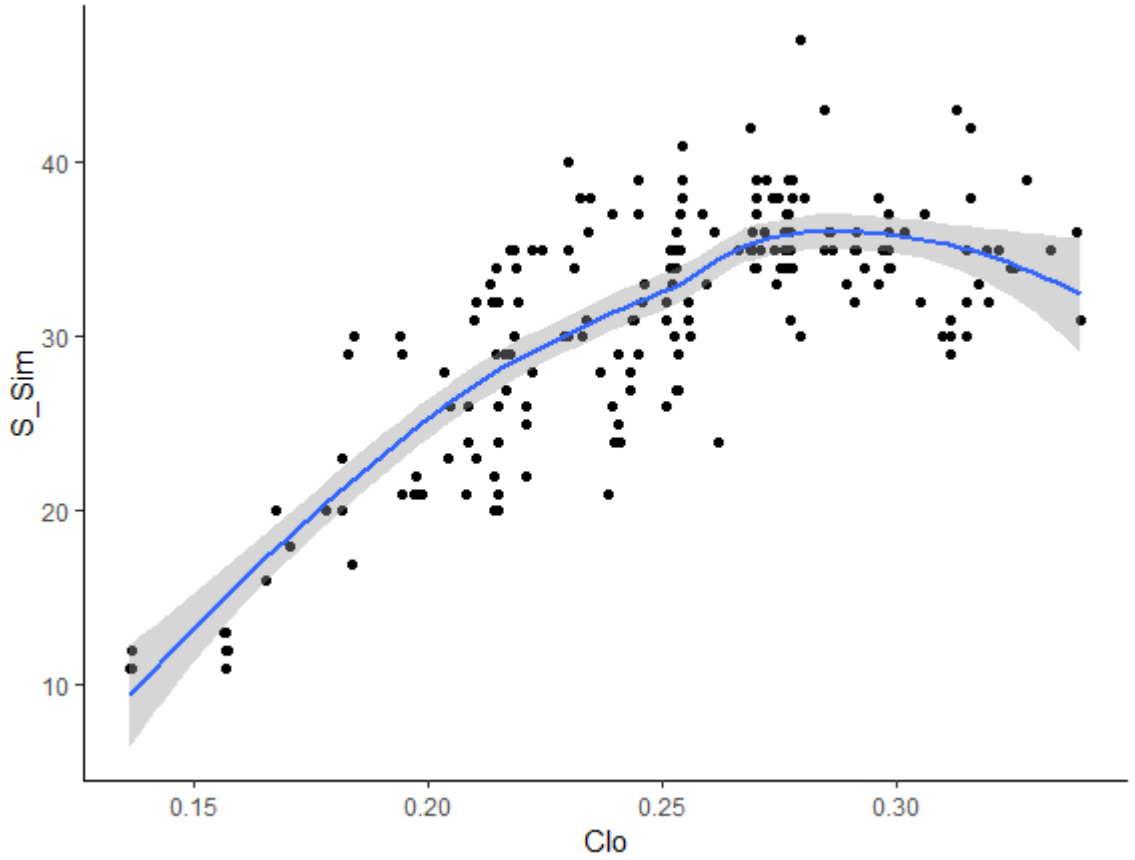

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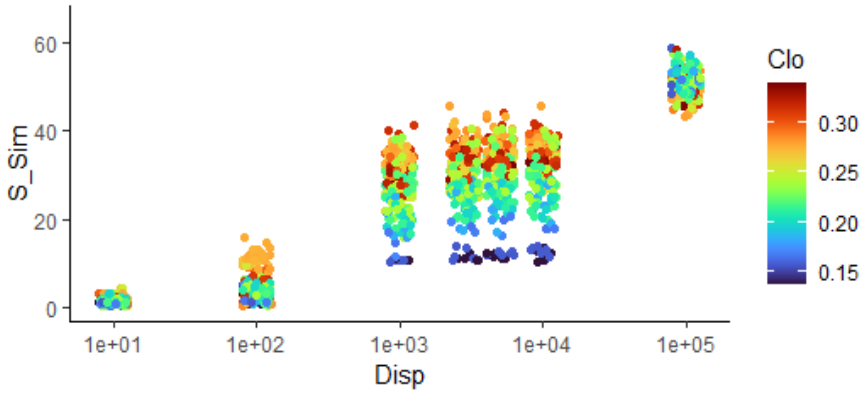

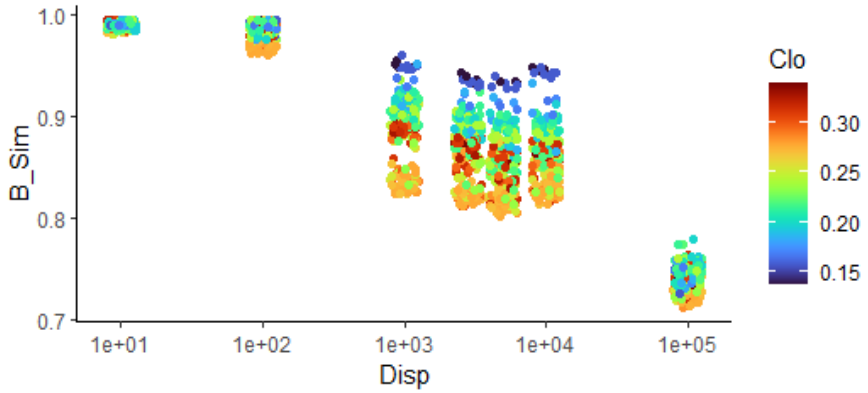

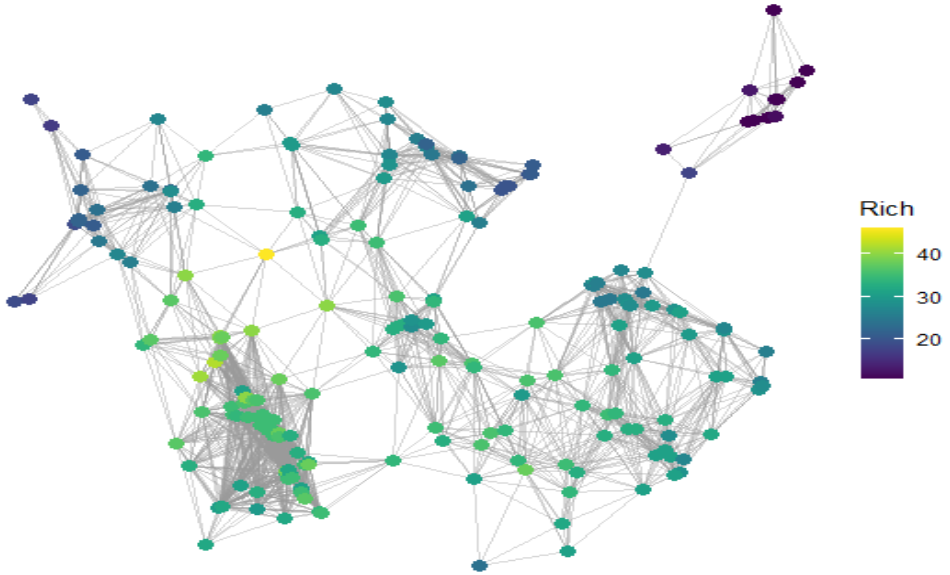

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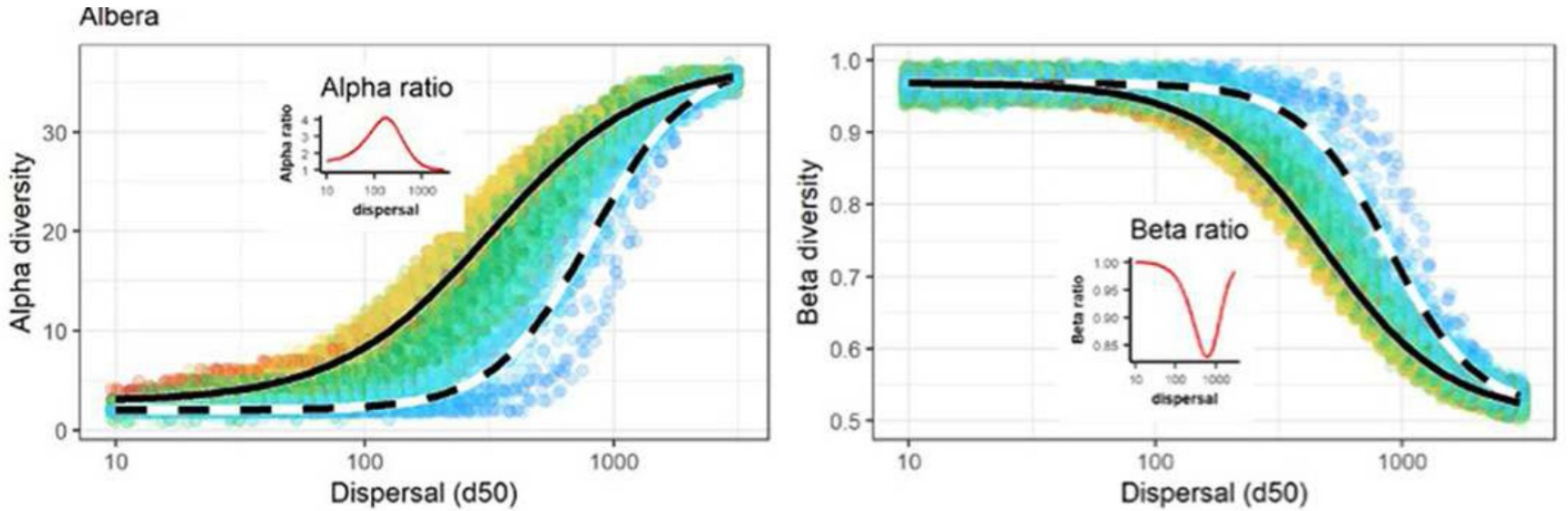

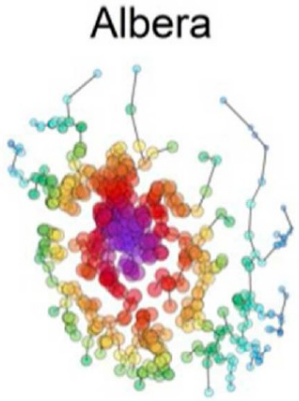

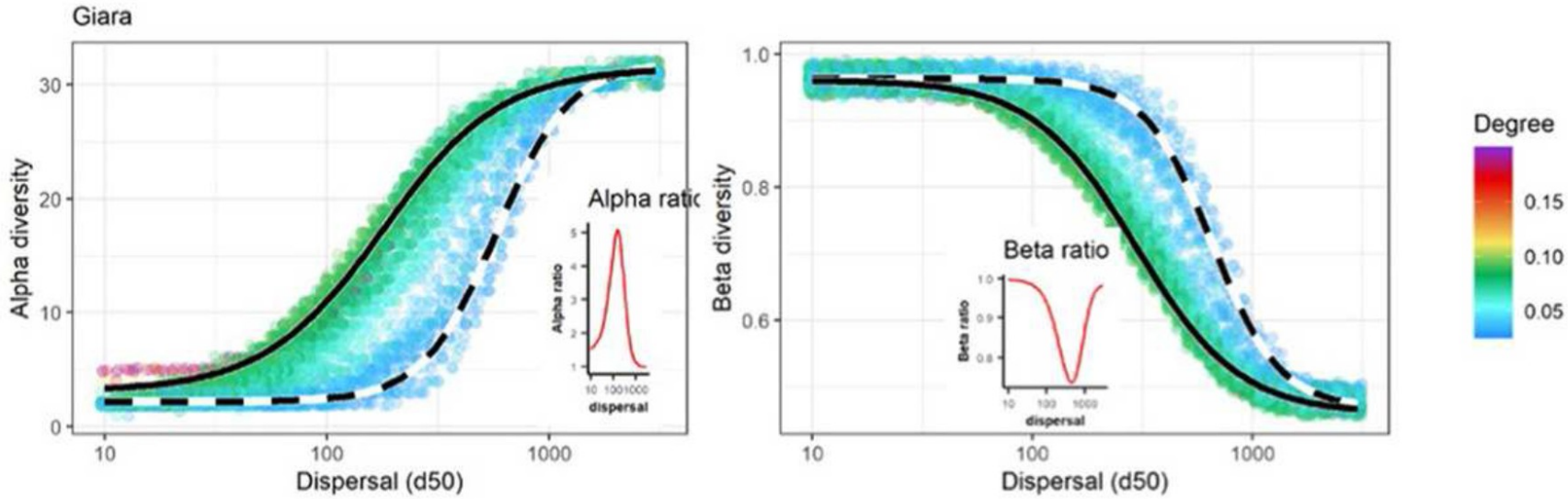

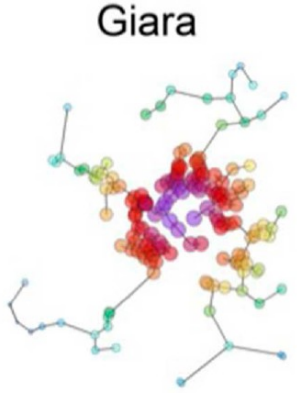

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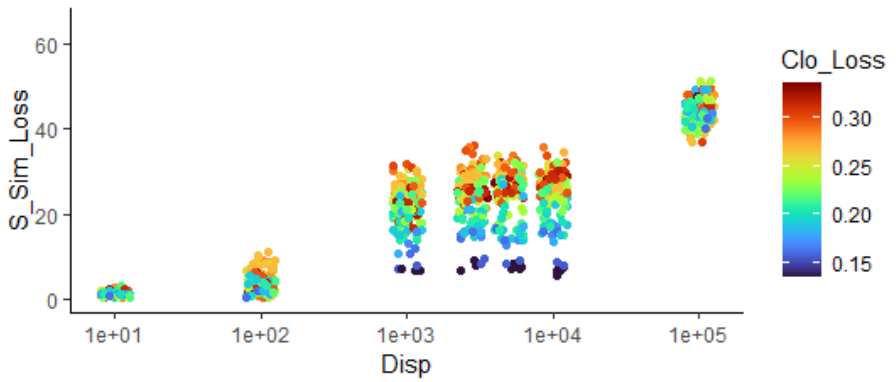
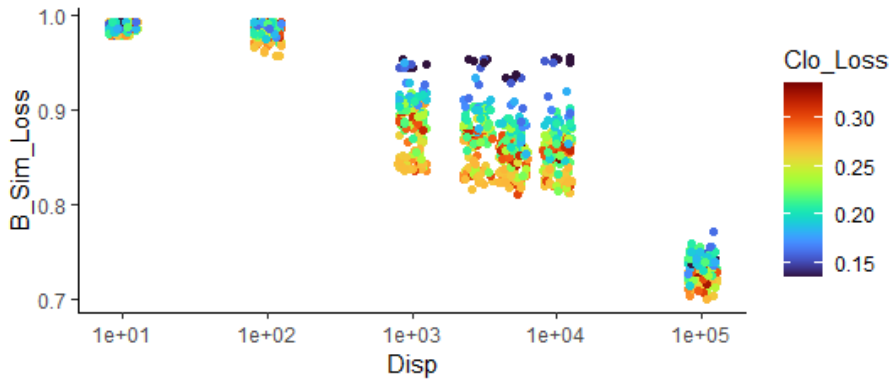
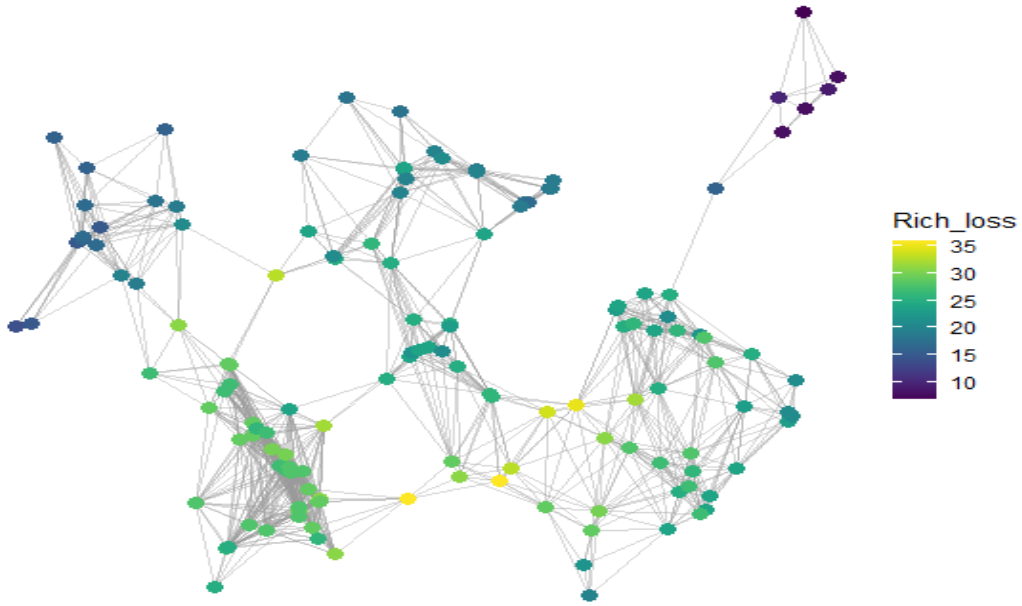
Connecting network structure with diversity







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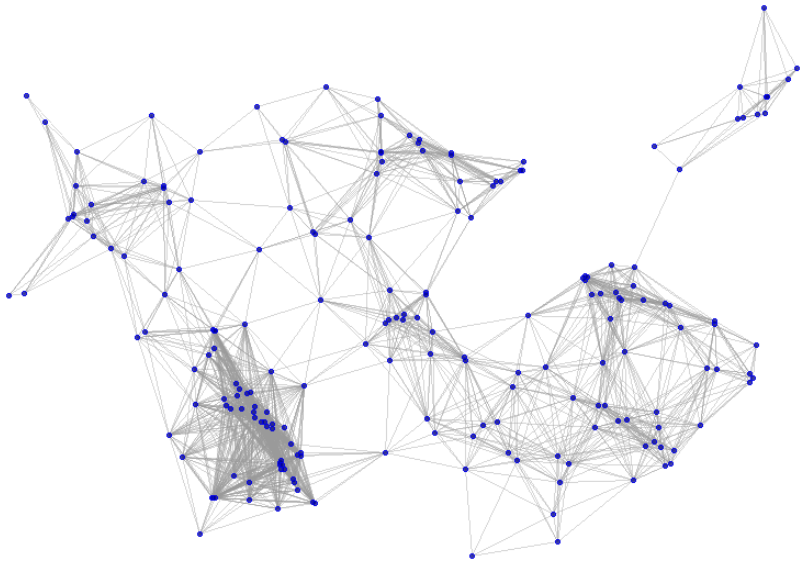
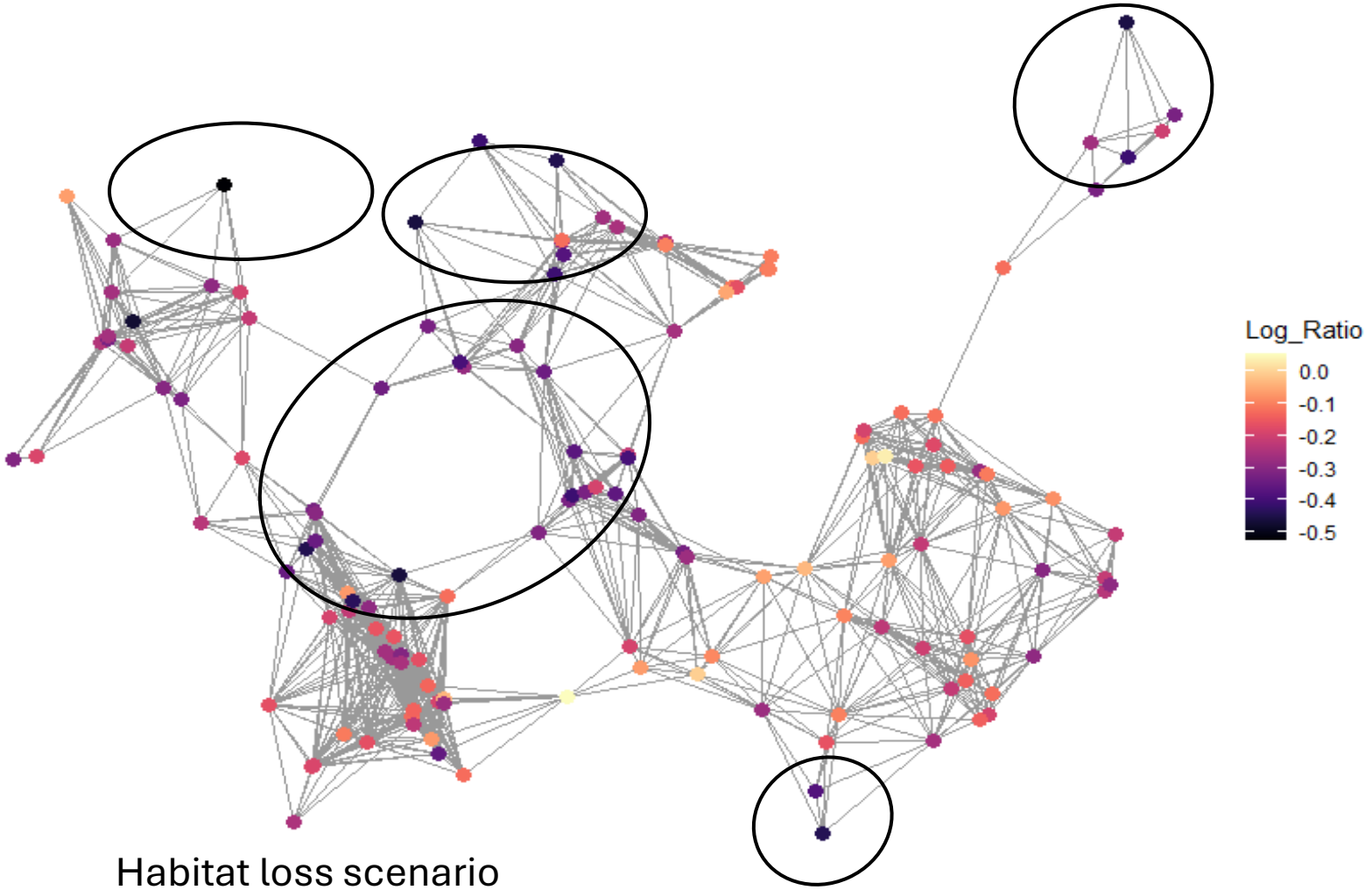


Original scenario



Habitat loss scenario