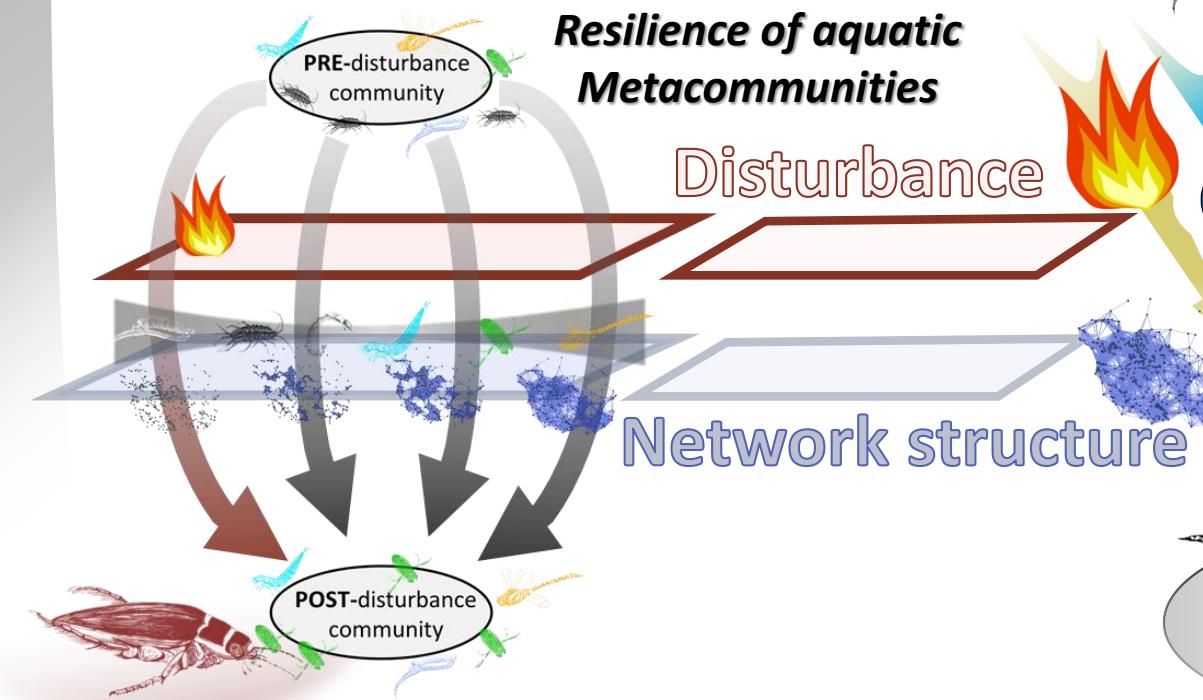
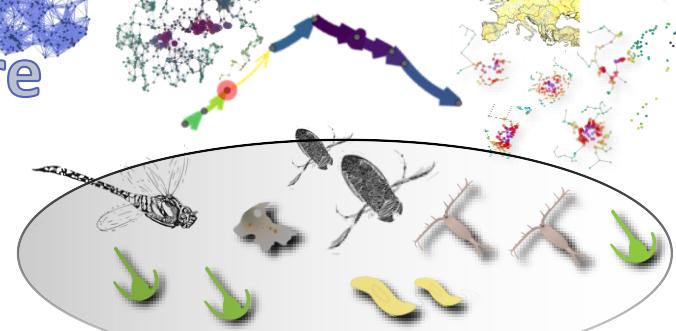


Resilience of aquatic Metacommunities



Network structure



Metacommunity theory

Liebold et al. 2004

Graph & network theory

Economo & Keitt 2010

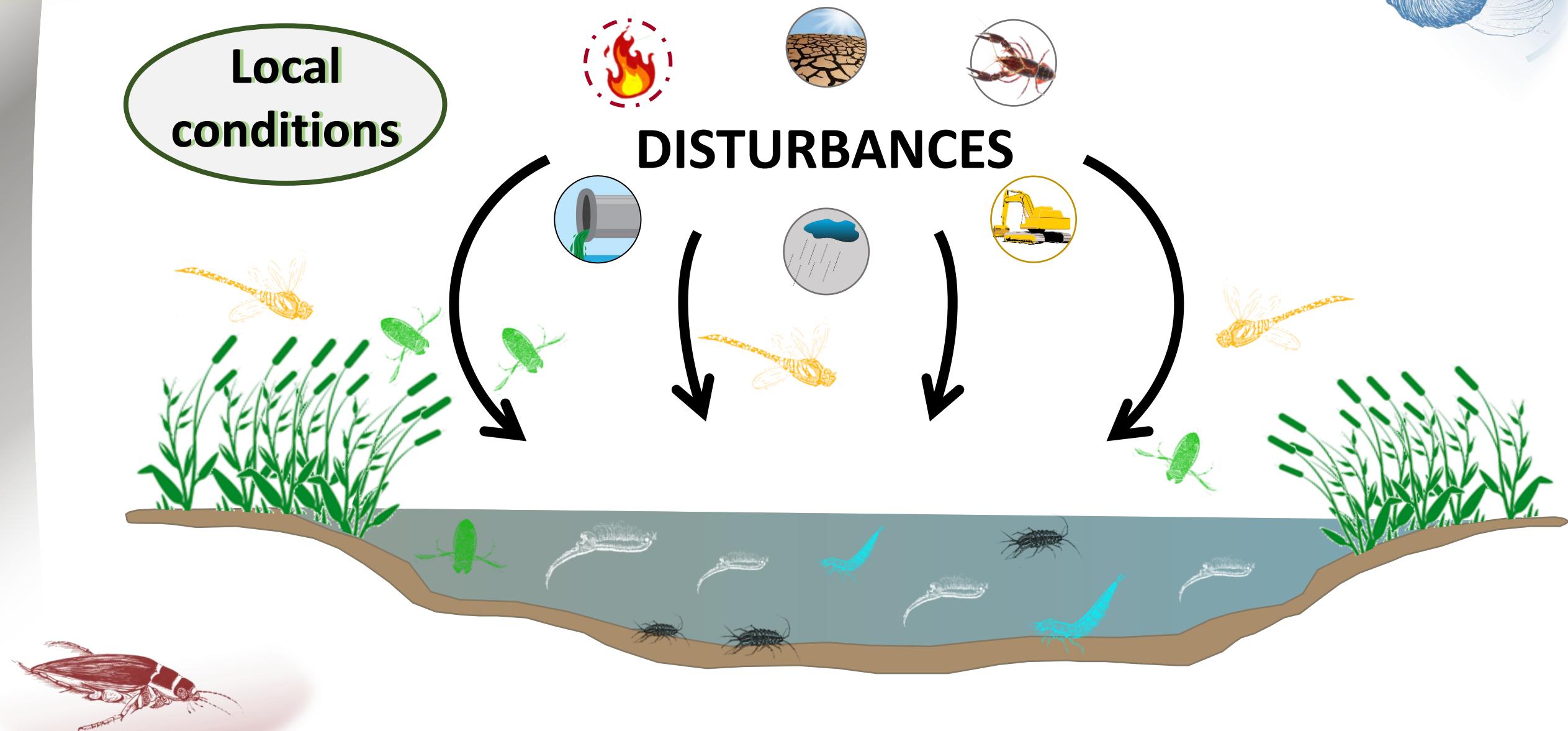
Null & neutral simulations

Hubbell 2001

Worm & Tittensor 2018

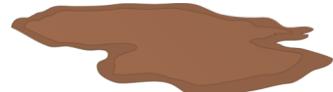
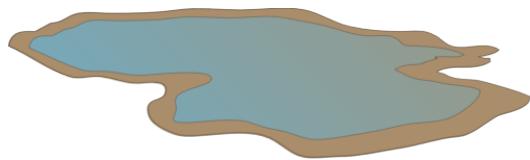
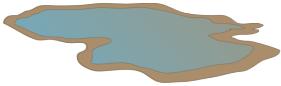
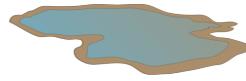
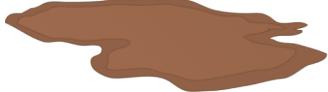
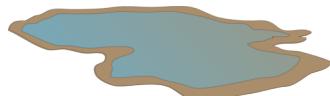
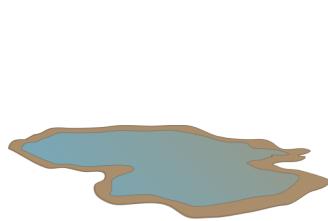


1. What might be assembling communities?

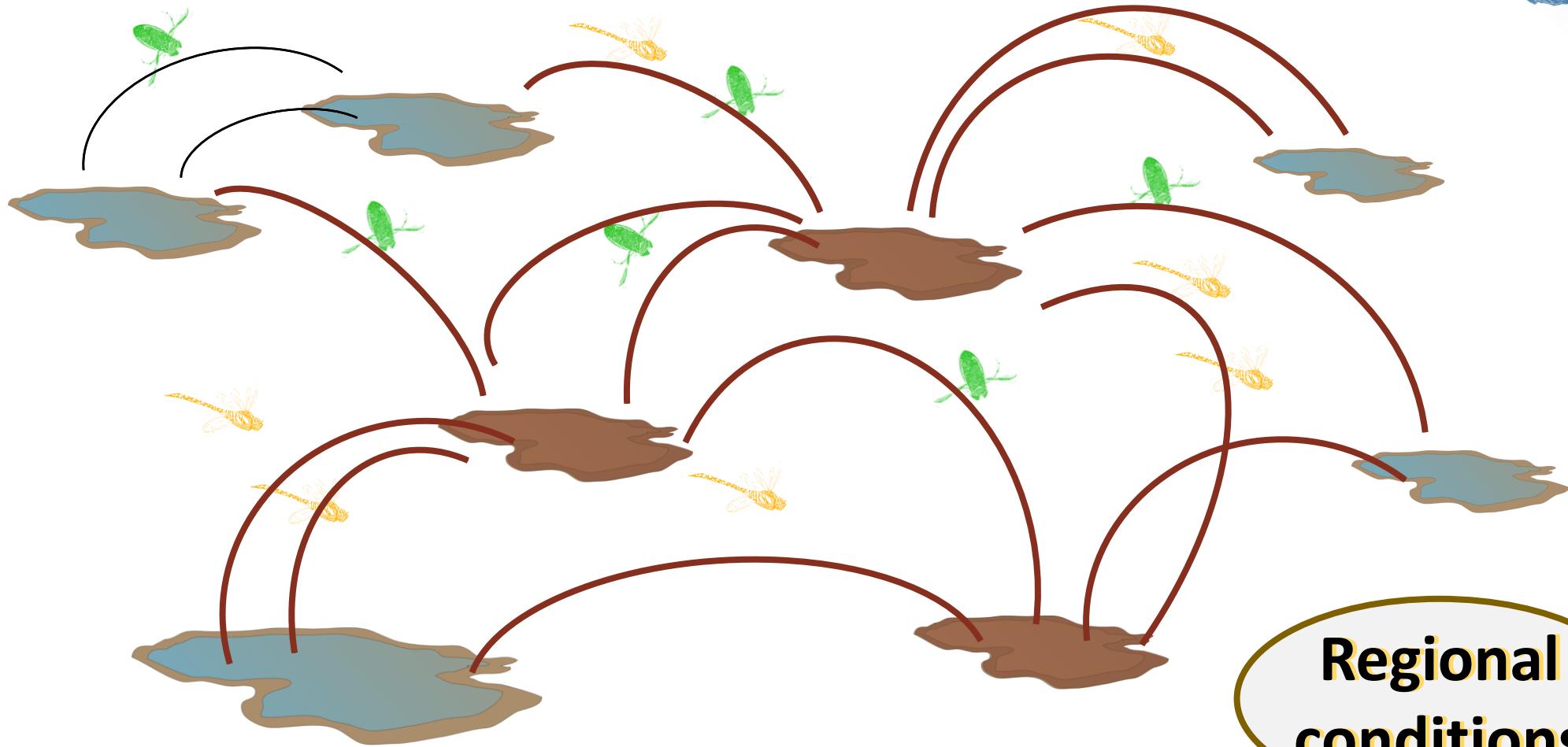




1. What might be assembling communities?



1. What might be assembling communities?



**Regional
conditions**



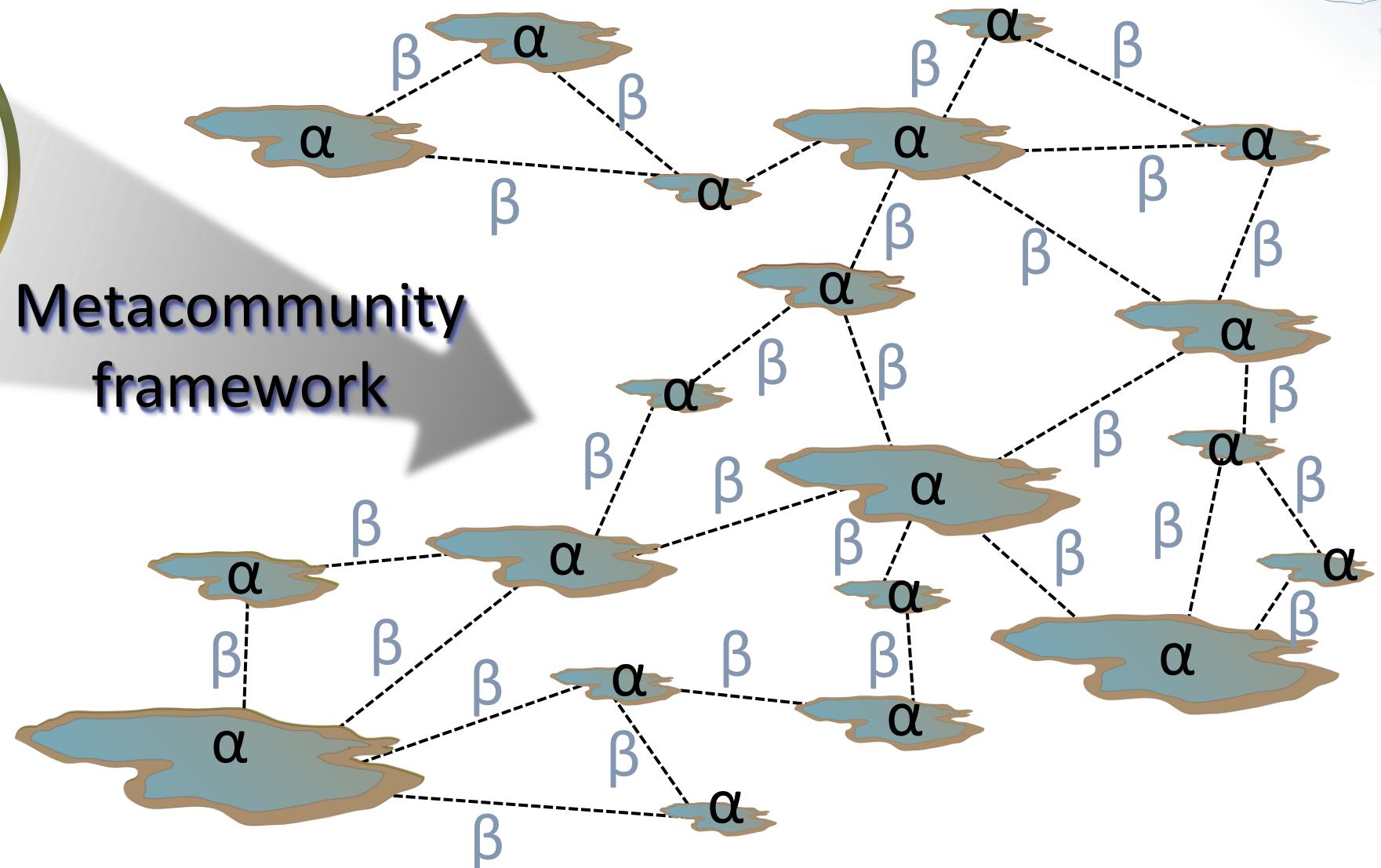
1. What might be assembling communities?



A set of local communities that are linked by dispersal of multiple potentially interacting species.

Leibold et al. (2004)

Metacommunity framework





1. What might be assembling communities?

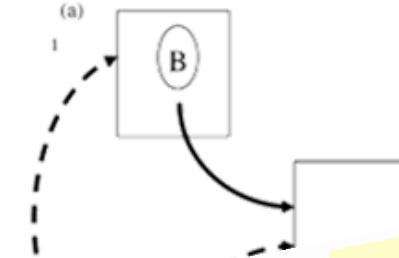
Models/Cases/Structures
("big four")



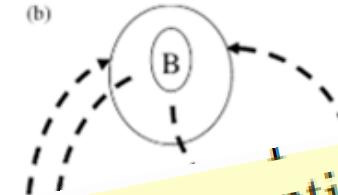
Leibold, M. A., and J. M. J. Fransen. 2018. Metacommunity Ecology. Princeton University Press.



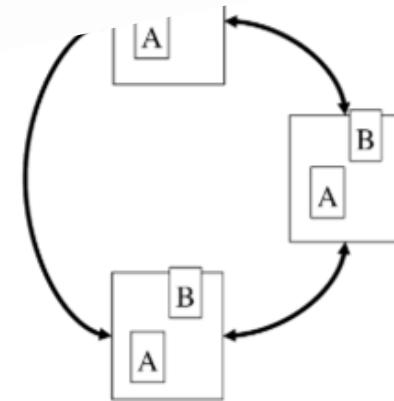
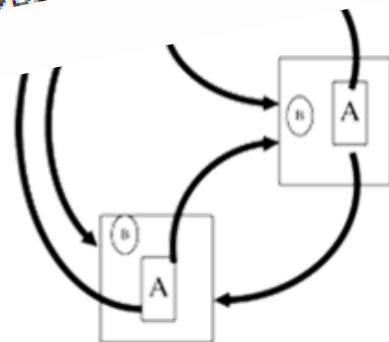
Patch dynamics



Species sorting

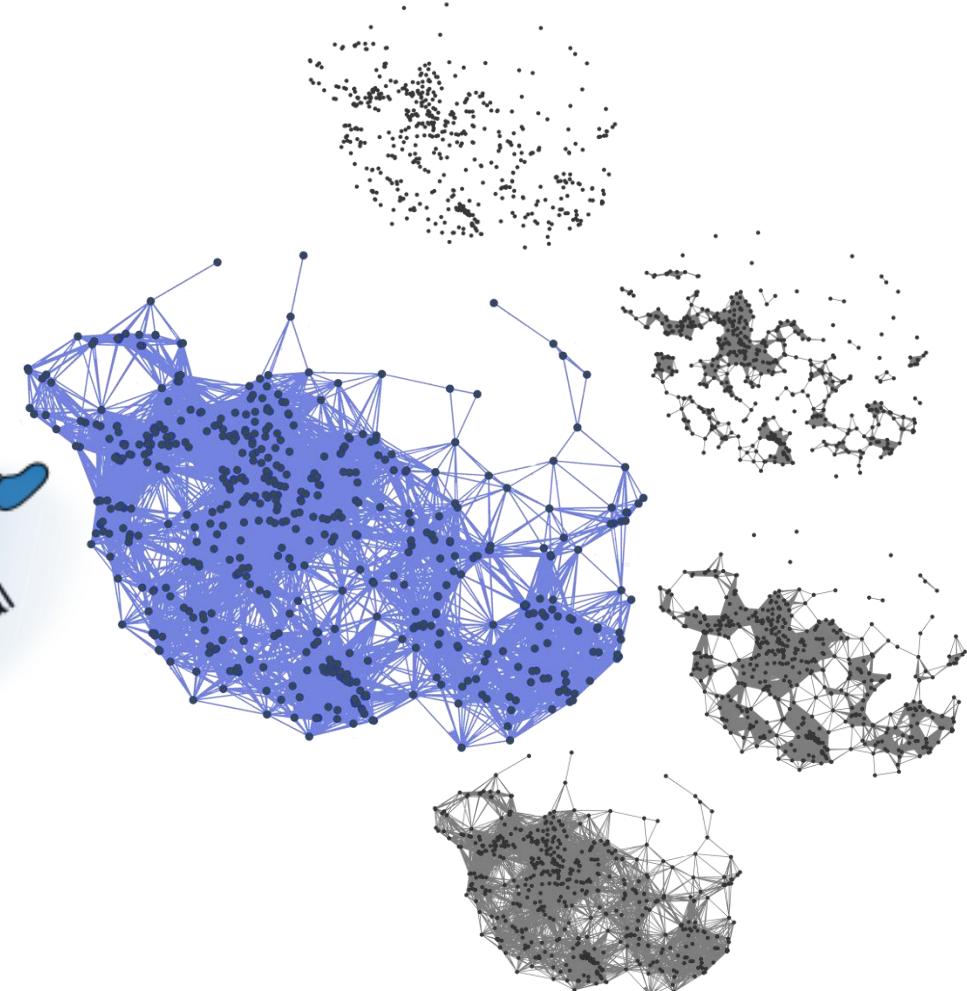
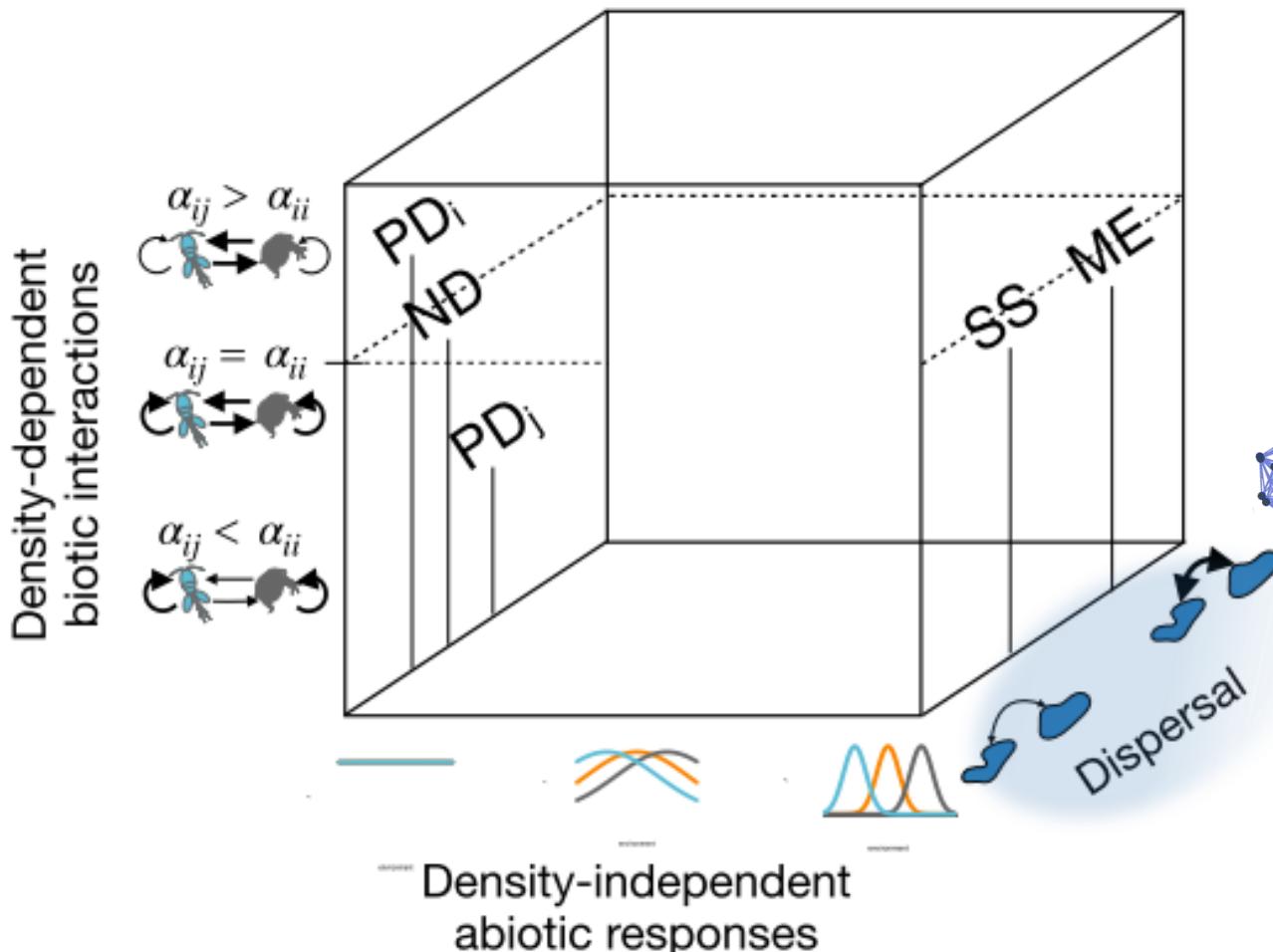


Progress in metacommunity ecology is hampered by continuing to think of the original four archetypes as alternative hypotheses rather than as interacting components. Future progress will require us to find ways to understand how multiple processes work jointly and interactively to affect diversity and composition of biotas across spatial scales.





1. What might be assembling communities?





2. Capturing metacommunities backbone

the graph point of view



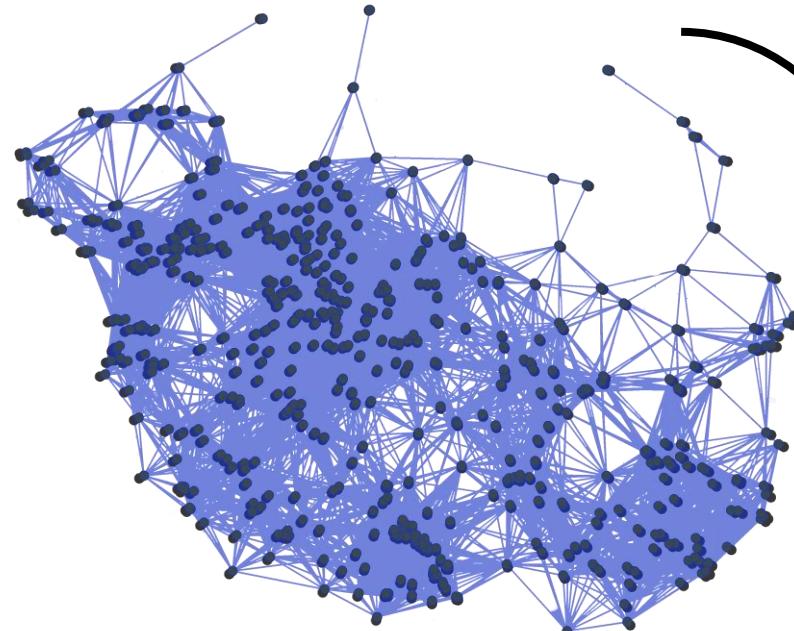
Metacommunity
framework



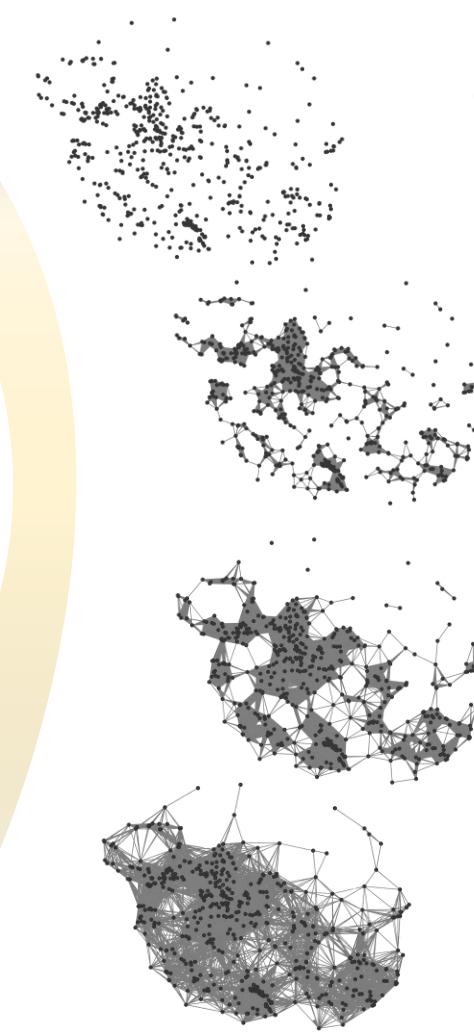


2. Capturing metacommunities backbone the graph point of view

Threshold distance



250 m
500 m
1000 m
1500 m
2500 m
2000 m
3000 m
 ≈ 3800 m
5000 m

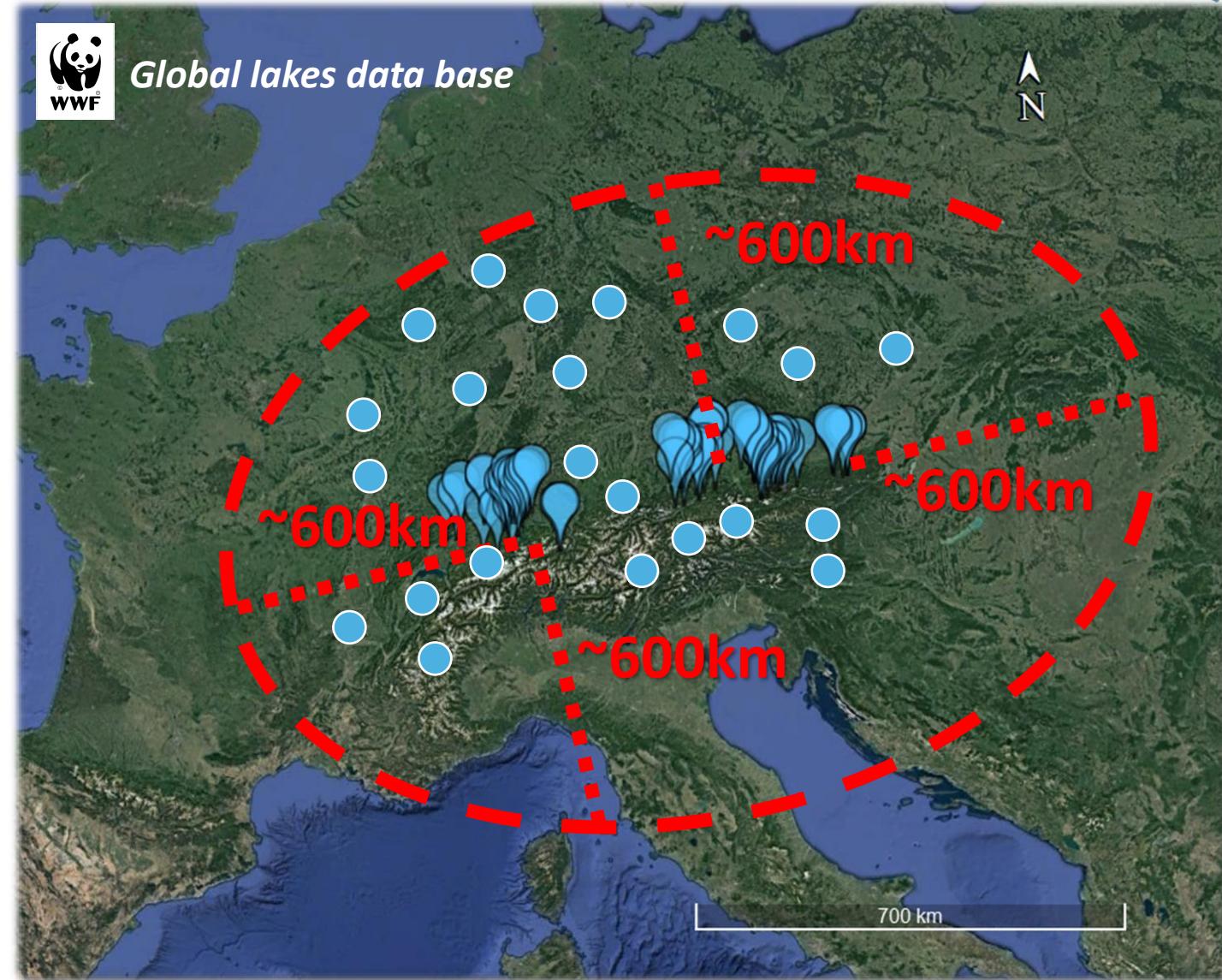
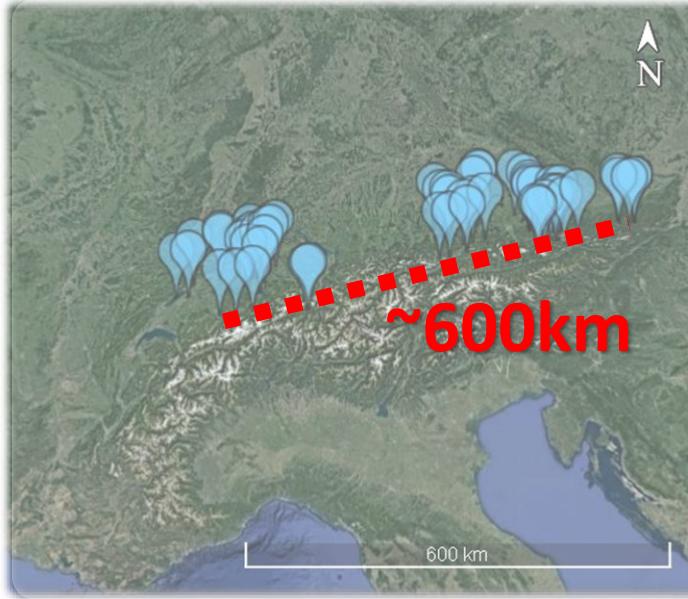


Dispersal ability



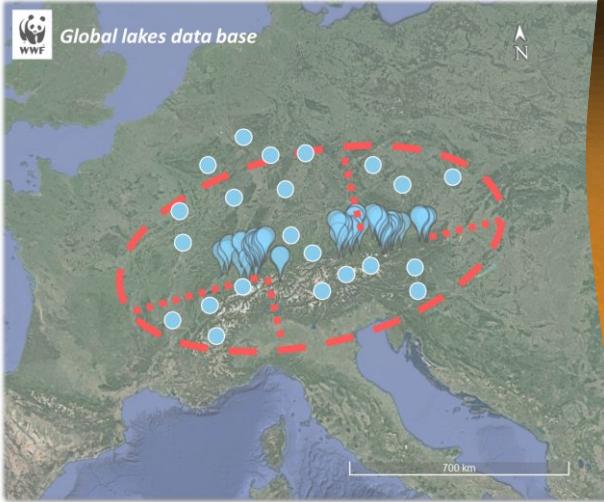


2. Capturing metacommunities backbone the graph point of view





2. Capturing metacommunities backbone the graph point of view



SCALE

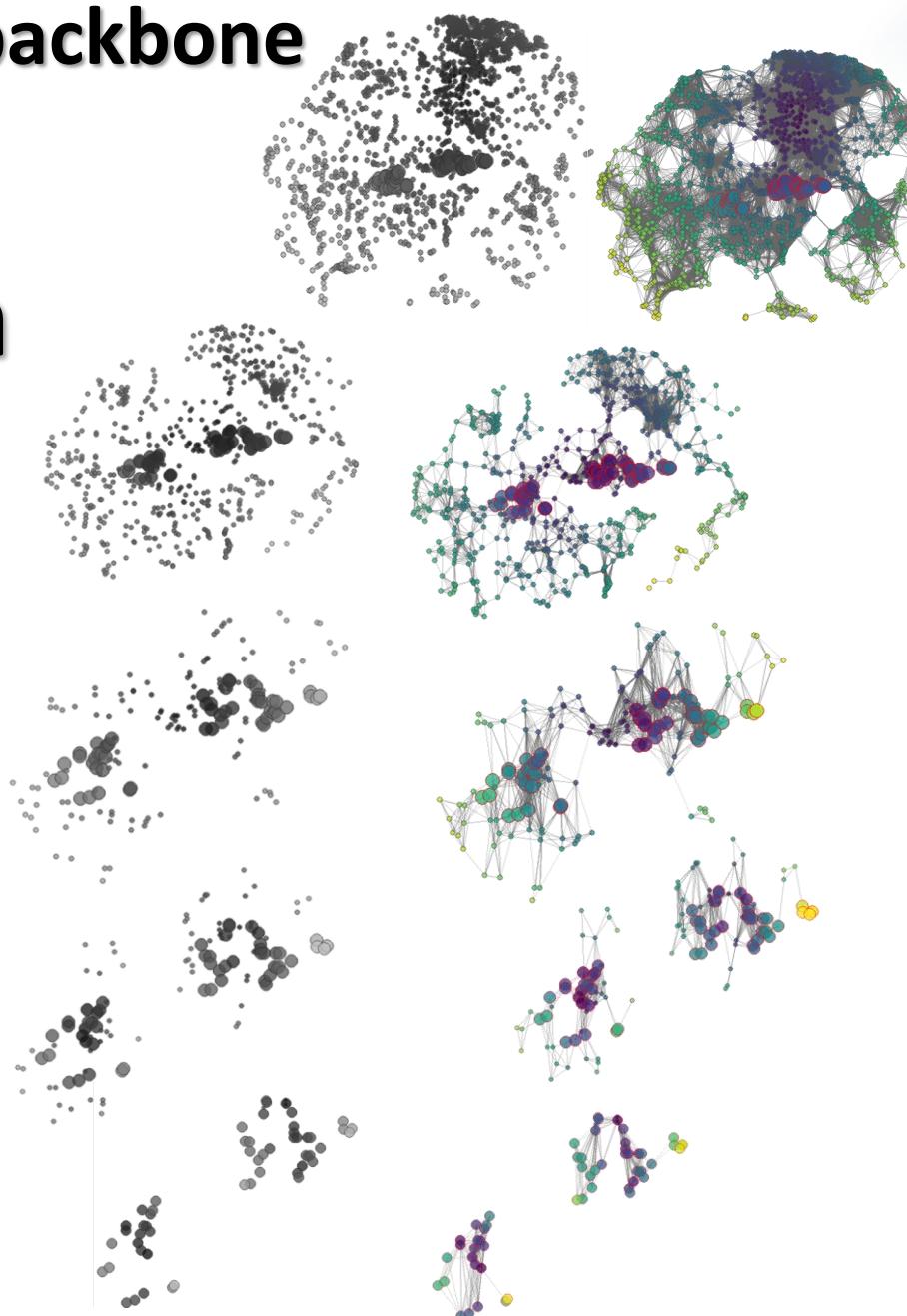
600 km

300 km

100 km

60 km

6 km



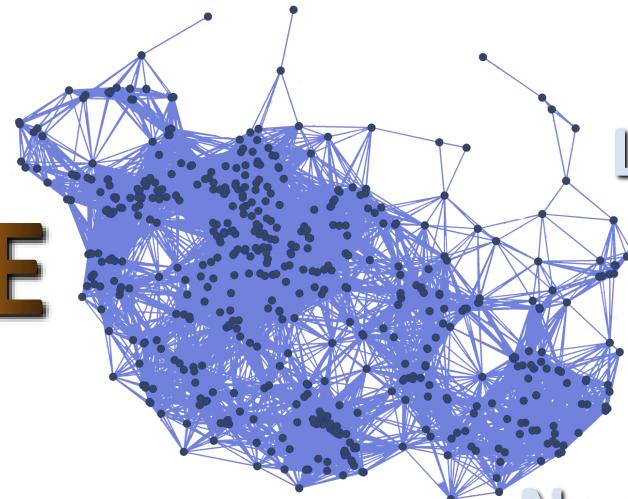


2. Capturing metacommunities backbone the graph point of view

Threshold distance

Dispersal ability

SCALE



Links meaning

An effective path between two communities throughout individuals can be exchanged.

Nodes meaning

A defined community (pond, forest, patch of habitat)



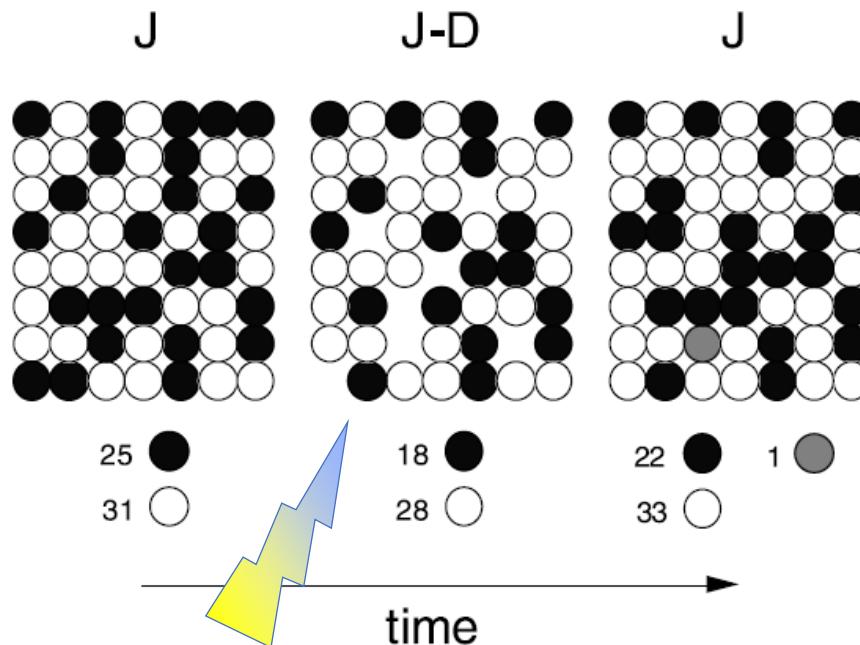


Null & neutral simulations

Neutral theory

Hubbell, (2001).
Princeton University Press.

Random extinction, dispersal and speciation



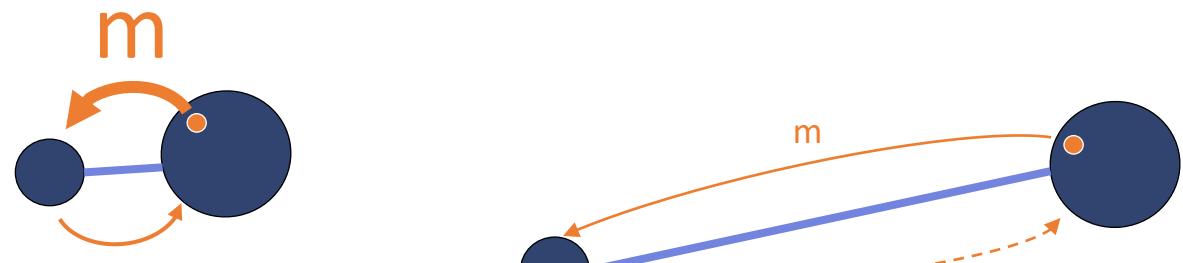
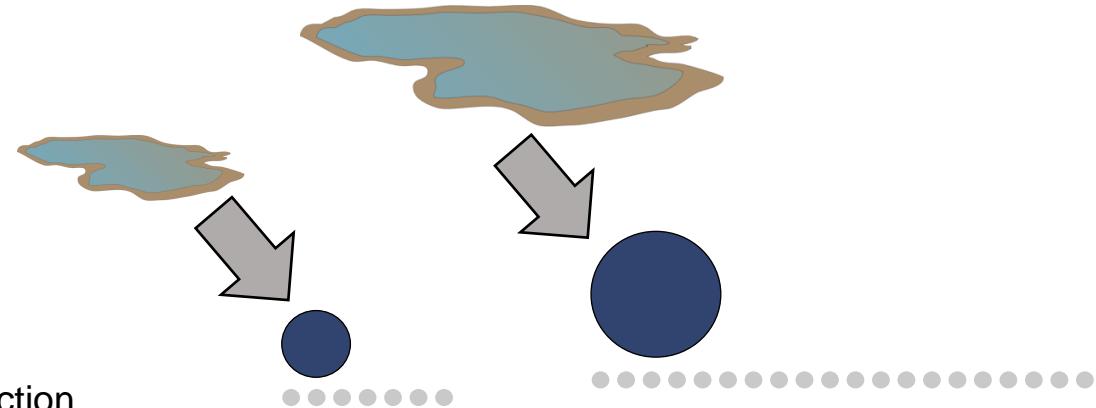
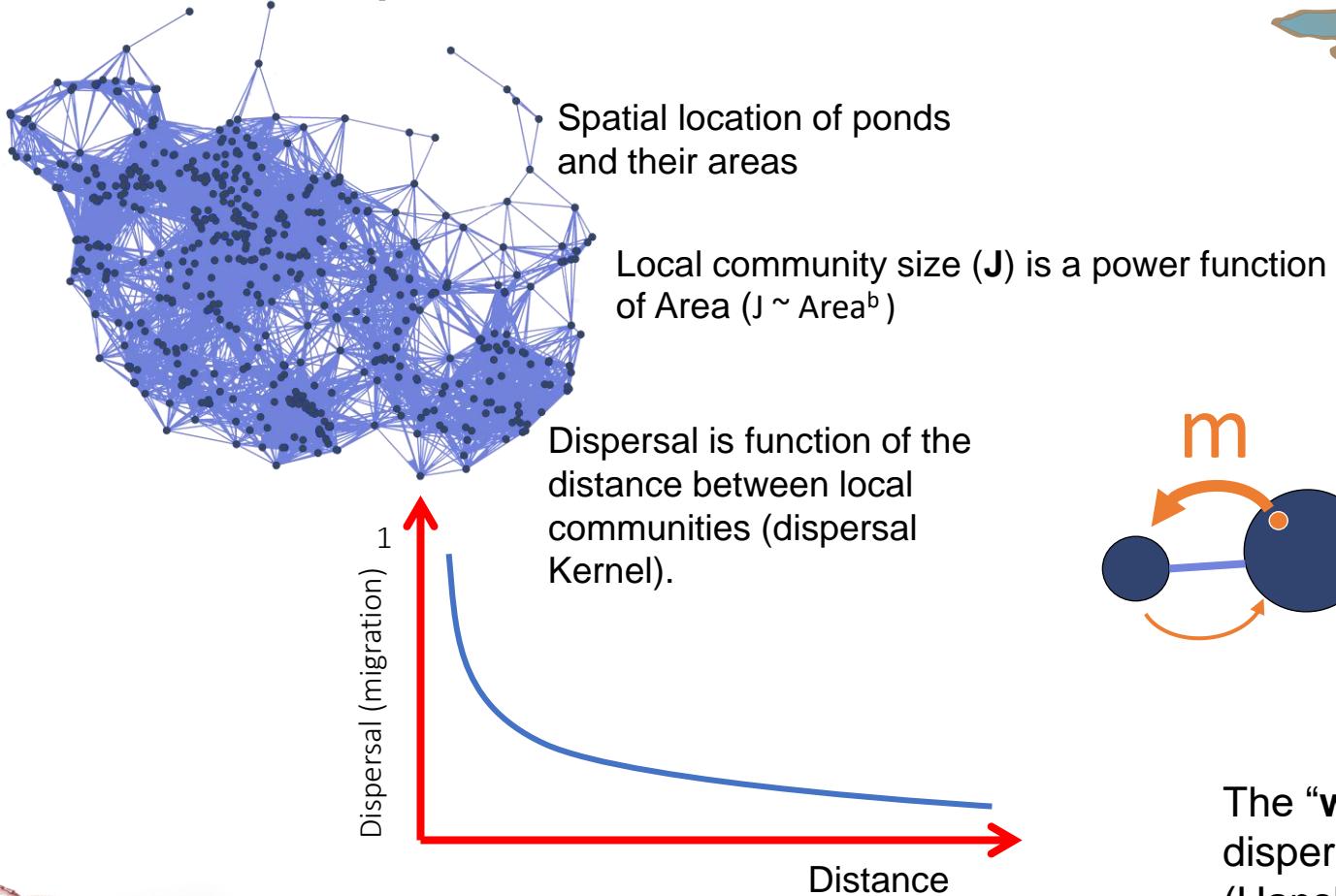
“Disturbance cycle”





Null & neutral simulations

Observed landscape structure

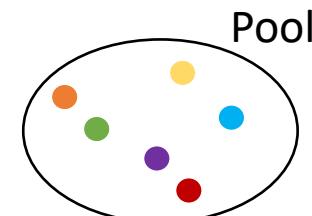
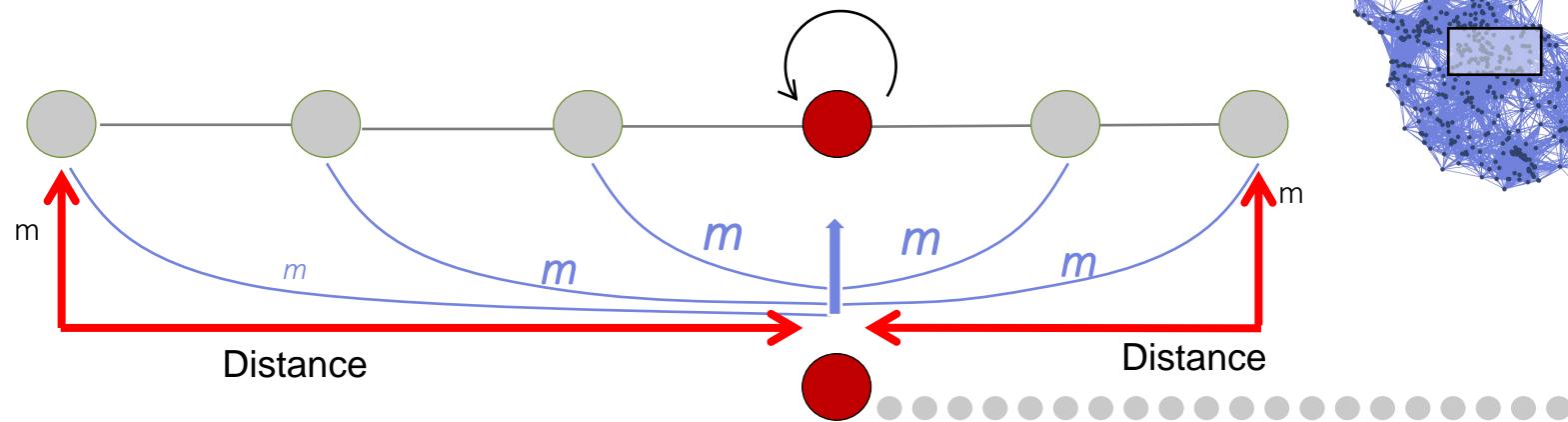


The “**weight**” of links are determined by the expected dispersal, times the size of the source community (Hanski 1999)



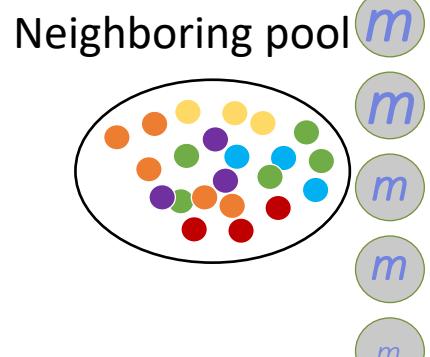
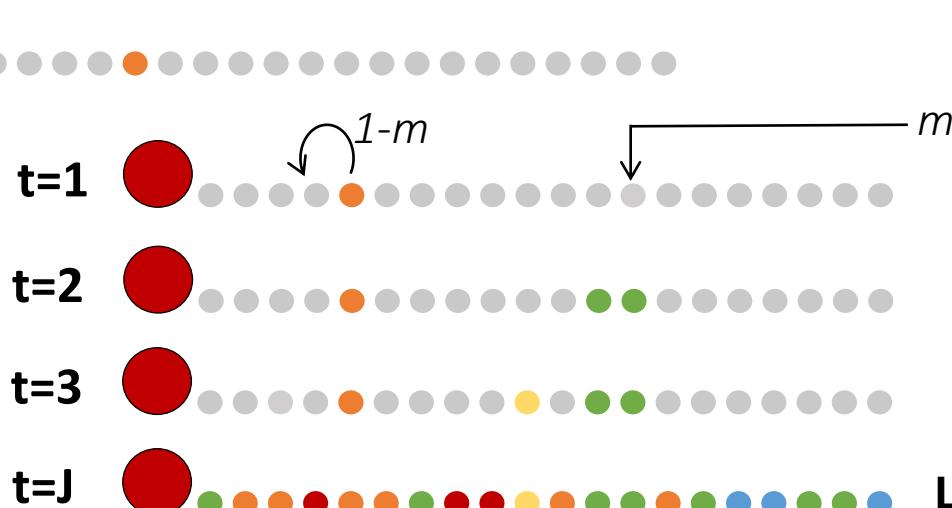


Null & neutral simulations



t=0 1 individual in each pond from the pool

Individuals are incorporated with probability $m=f(\text{distance})$ from neighbor communities and $1-m$ from the same community. Until community size is filled J



Local community



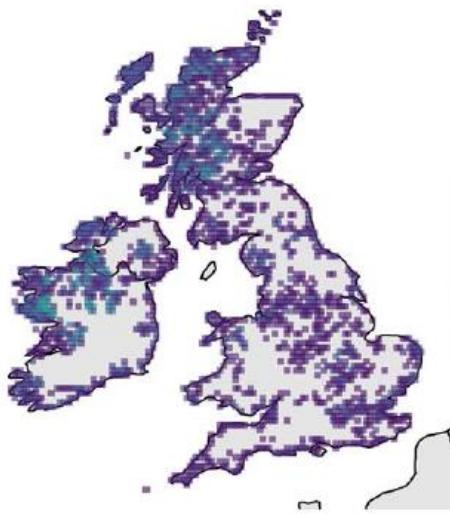
Coalescent biodiversity model



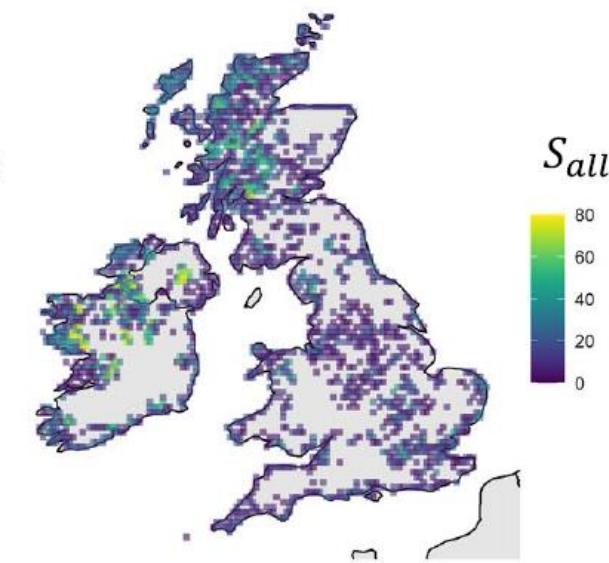
Null & neutral simulations

Coalescent biodiversity model

i. Dispersal only through permanent habitats



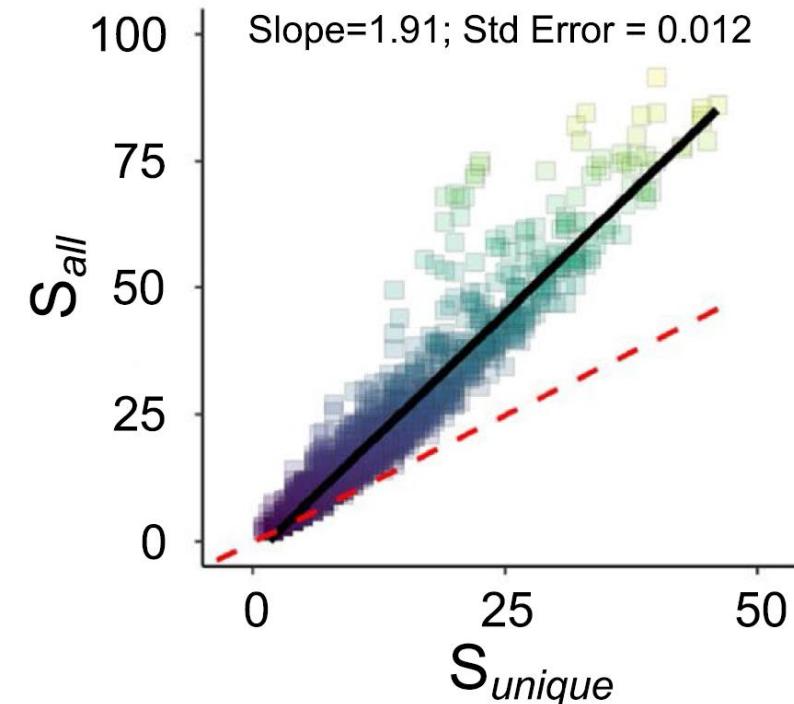
ii. Dispersal through ephemeral, temporal and permanent habitats



The contribution of other aquatic systems (ephemeral waters) to the diversity of permanent waters.

Waterscape relevance

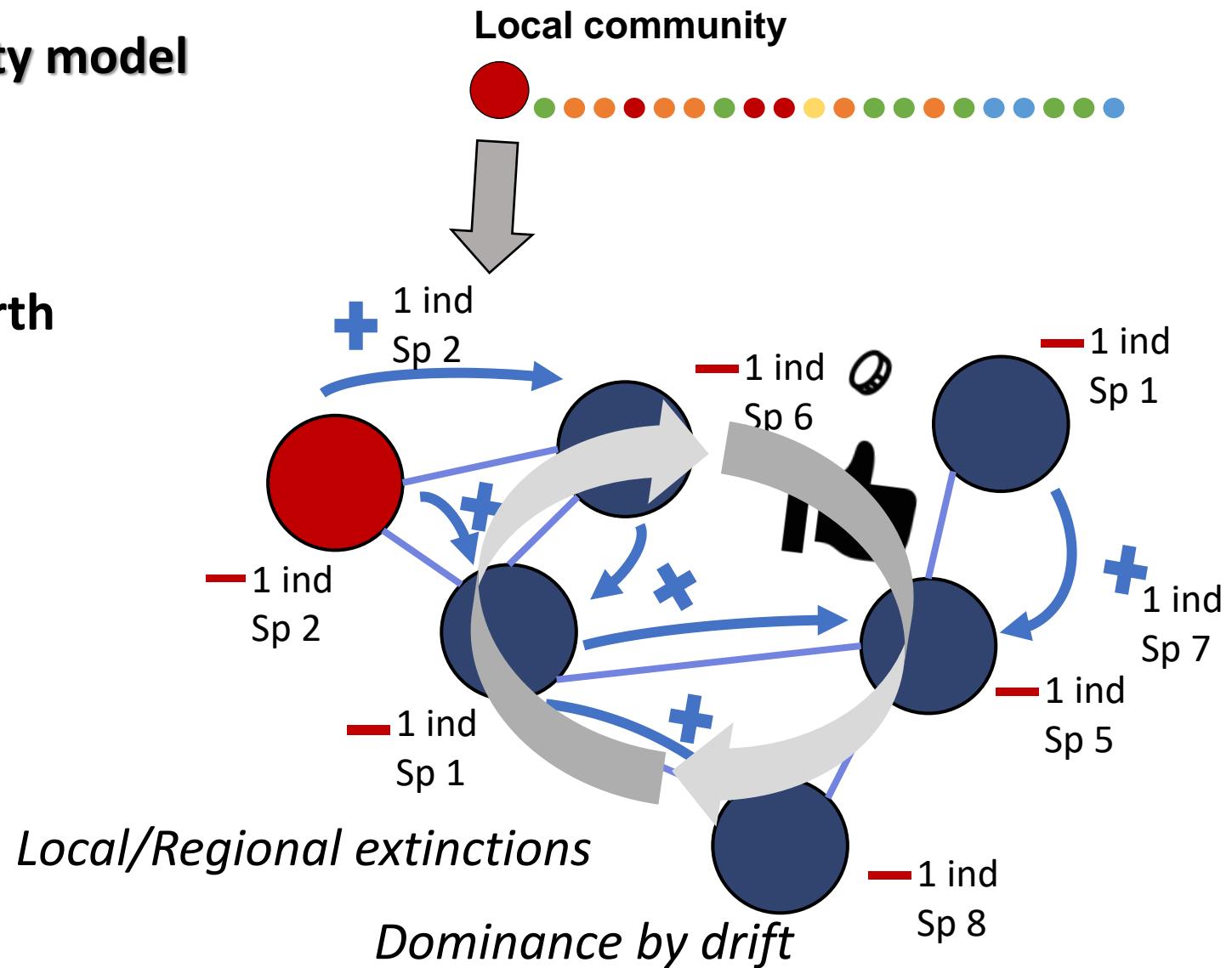
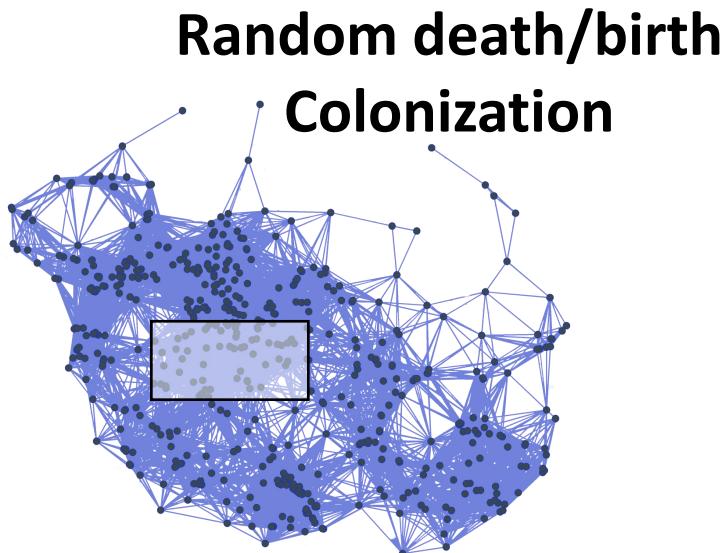
C) Permanent richness





Null & neutral simulations

Coalescent + lottery diversity model



METHODS

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1

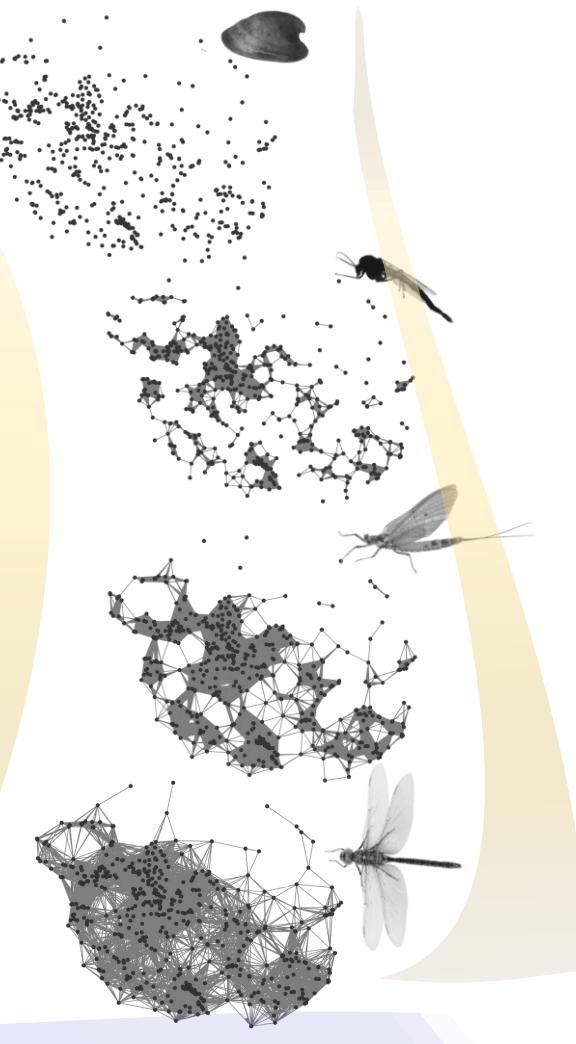
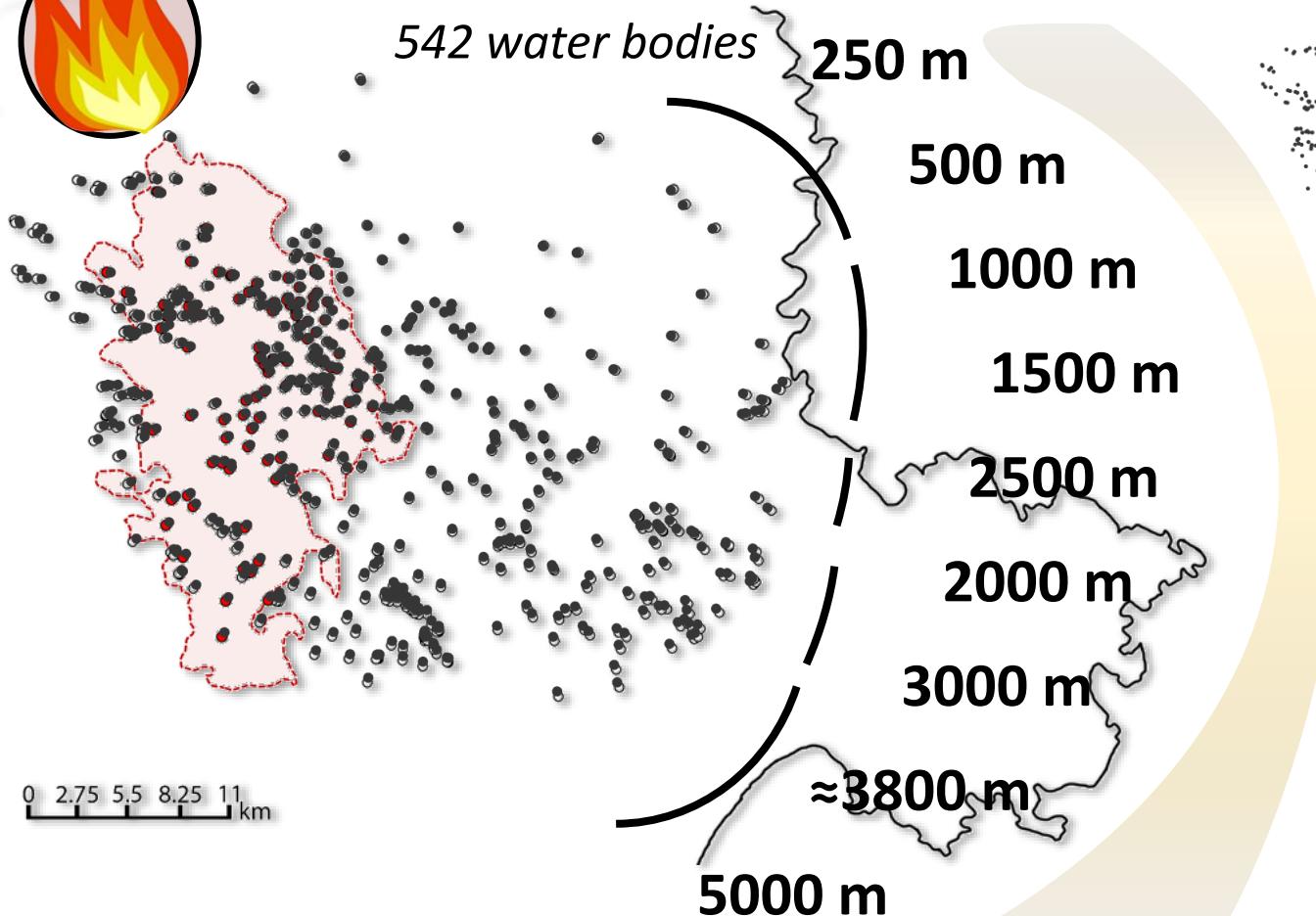
Build the different graphs for the studied network



Alt Empordà wildfire, 2012

13000 ha

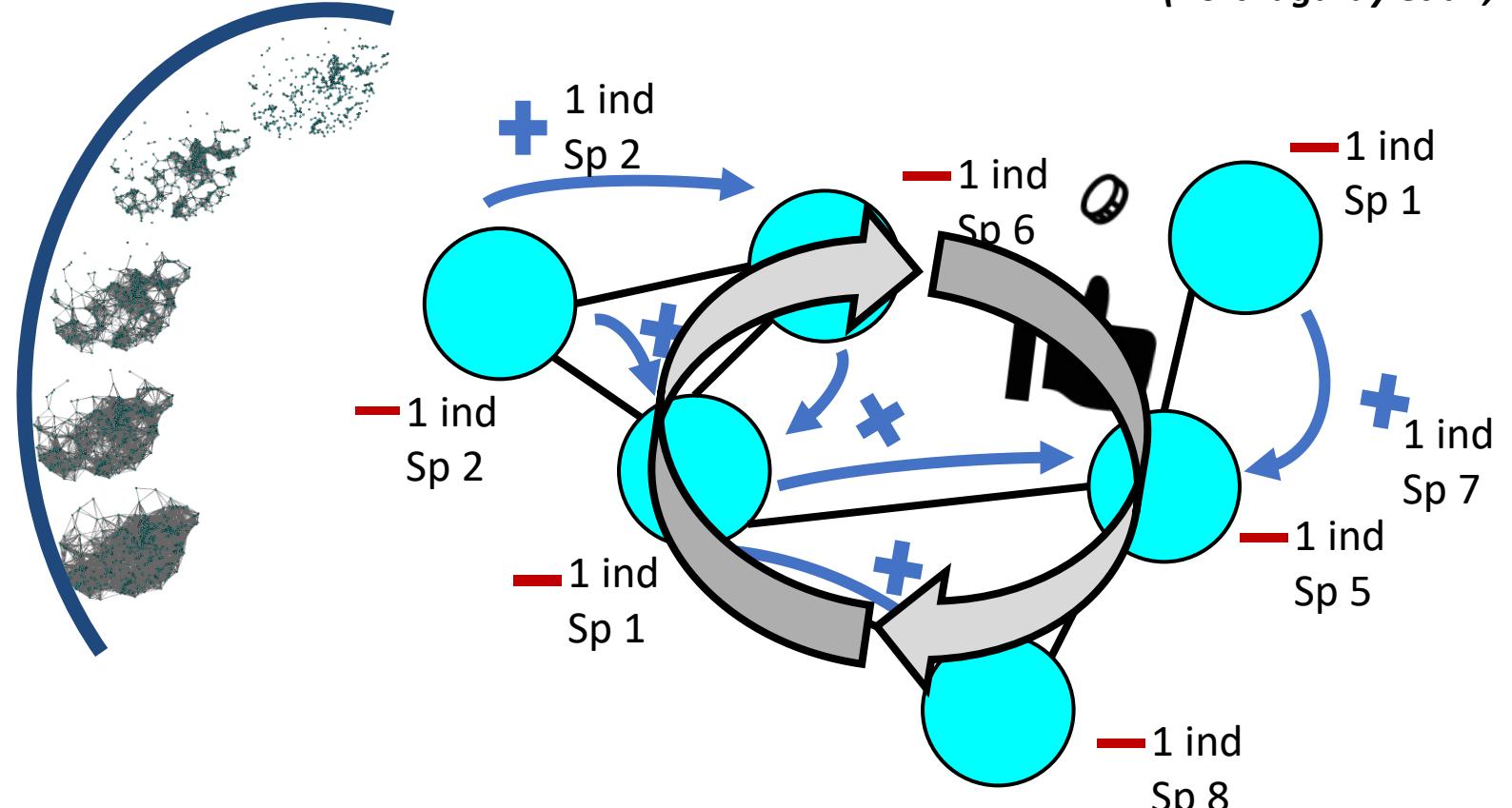
542 water bodies



METHODS

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20 individuals
200 species

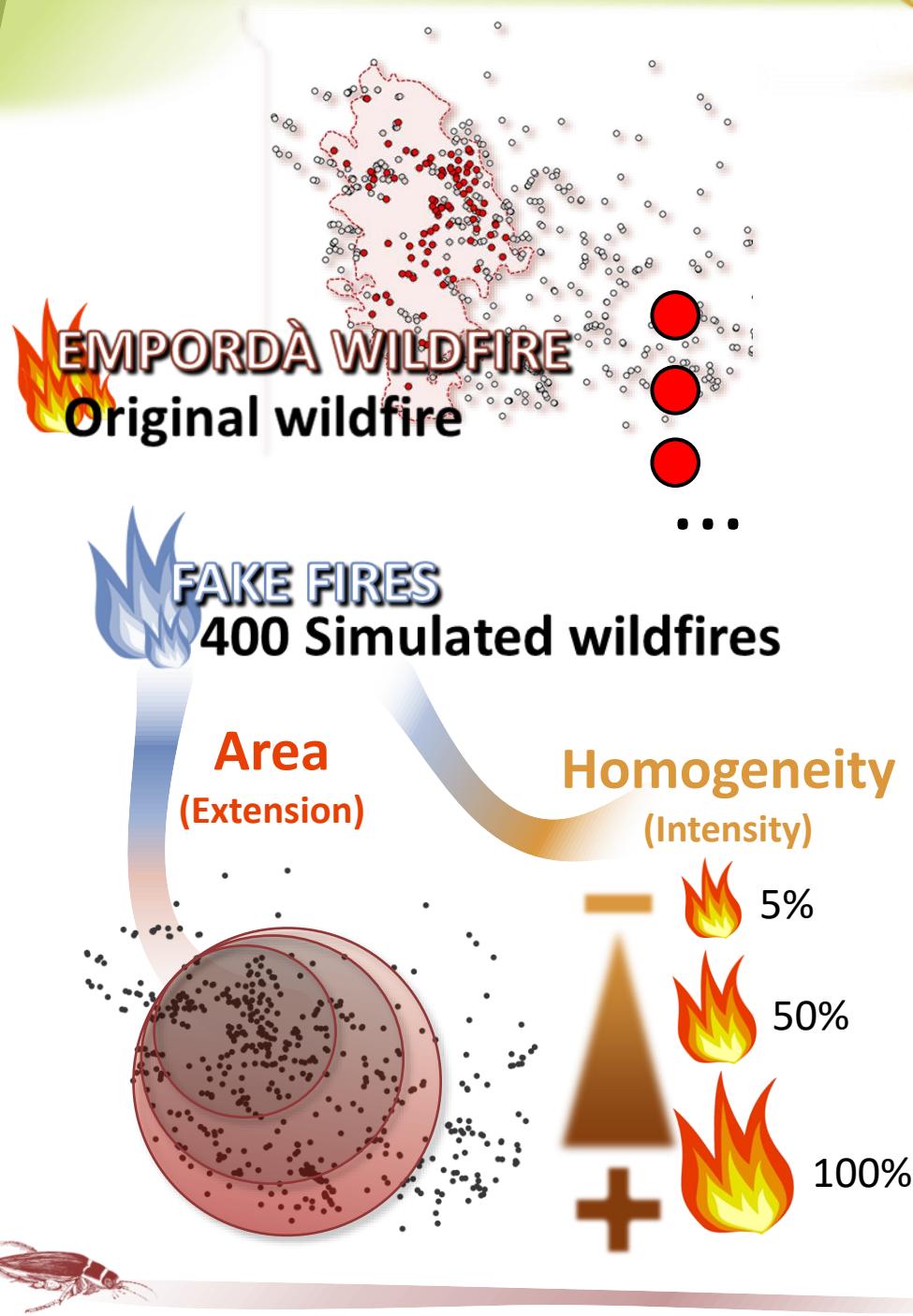


- 1 Build the different graphs for the studied network
- 2 Simulate the network metacommunity
(Borthagaray et al., 2014)

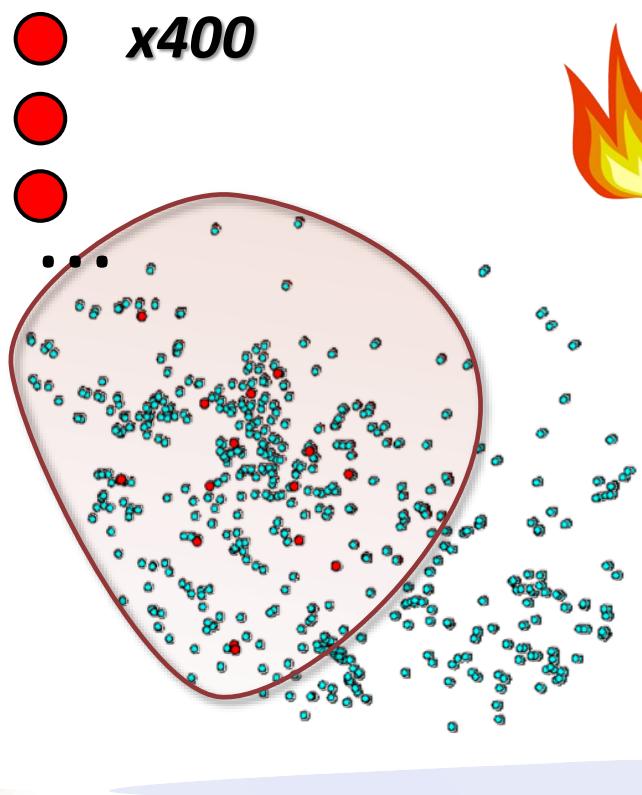
Borthagaray et al., 2014. *Ecography* 37, 564–571

METHODS

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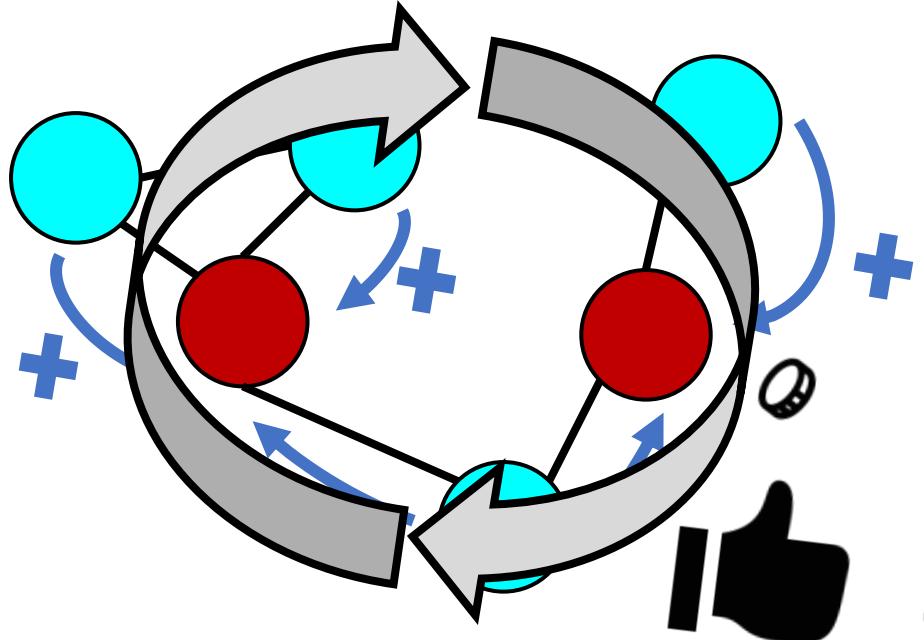
- 1 Build the different graphs for the studied network
- 2 Simulate the network metacommunity
(Borthagaray et al., 2014)
- 3 Fake fires and select BURNED local communities



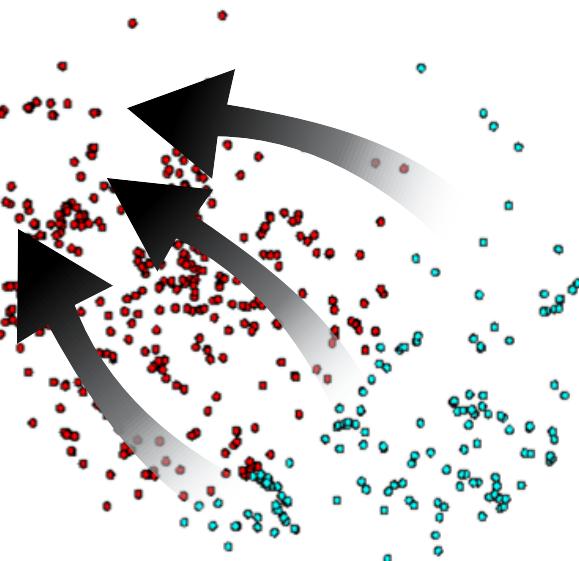
Burn the community
0 species
0 individuals
Elimination of the whole community

METHODS

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Coalescent process



- 1 Build the different graphs for the studied network
- 2 Simulate the network metacommunity
(Borthagaray et al., 2014)
- 3 Fake fires and select BURNED local communities
- 4 Simulate a RECOLONIZATION process

METHODS

@david_cunillera



- 1 Build the different graphs for the studied network
- 2 Simulate the network metacommunity
(Borthagaray et al., 2014)
- 3 Fake fires and select BURNED local communities
- 4 Simulate a RECOLONIZATION process

 **EMPORDÀ WILDFIRE**
Original wildfire

Mean RICHNESS
 $\text{it} = 1$

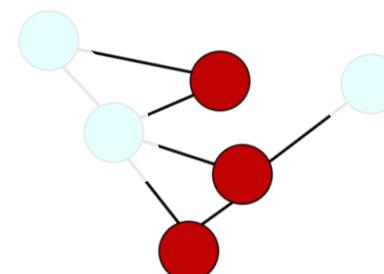
 **FAKE FIRES**
400 Simulated wildfires

Mean RICHNESS
 $\text{it} = 1$

Mean RICHNESS
 $\text{it} = 100$

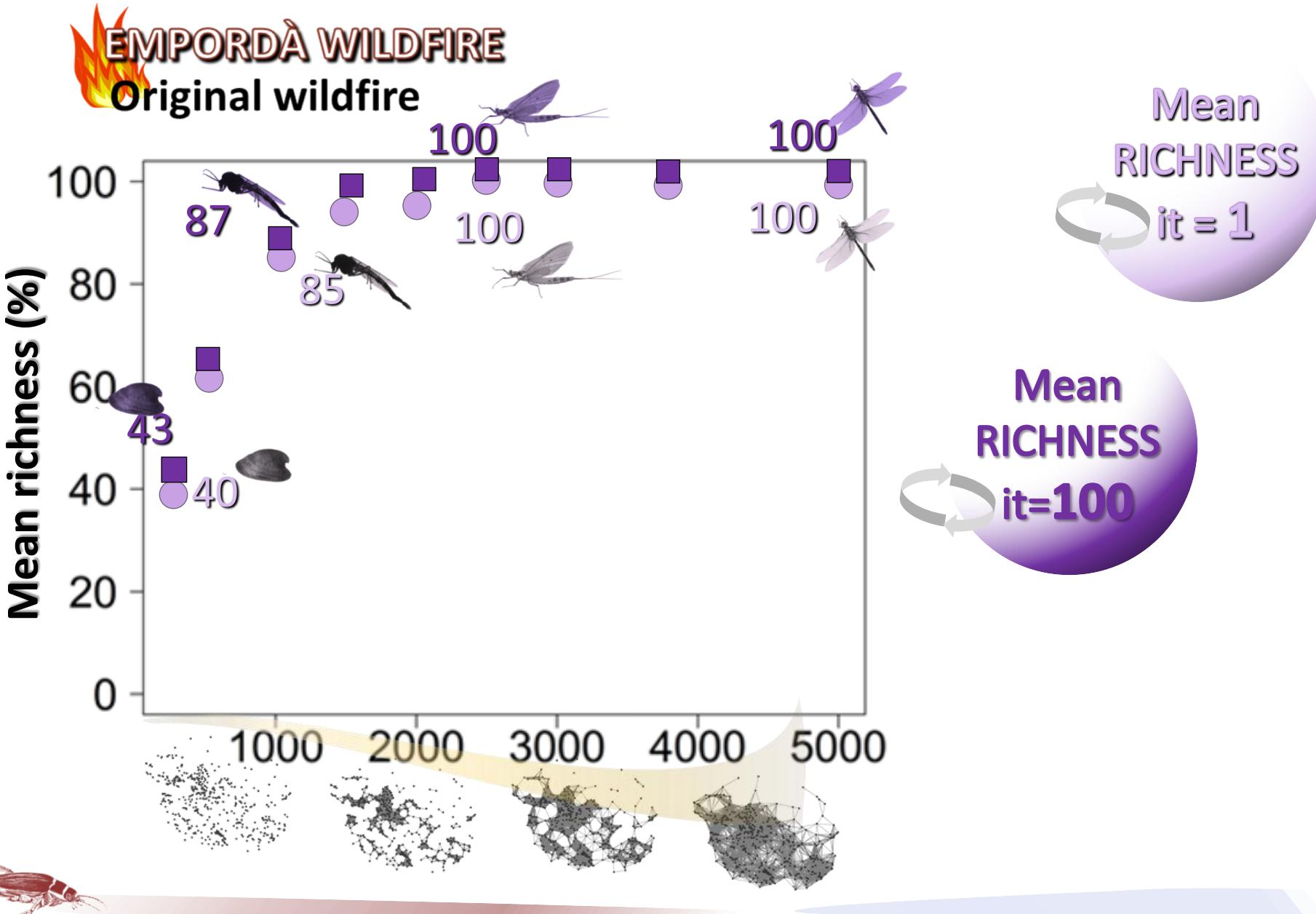
Mean RICHNESS
 $\text{it} = 1$

Mean RICHNESS
 $\text{it} = 100$



RESULTS and DISCUSSION

@david_cunillera

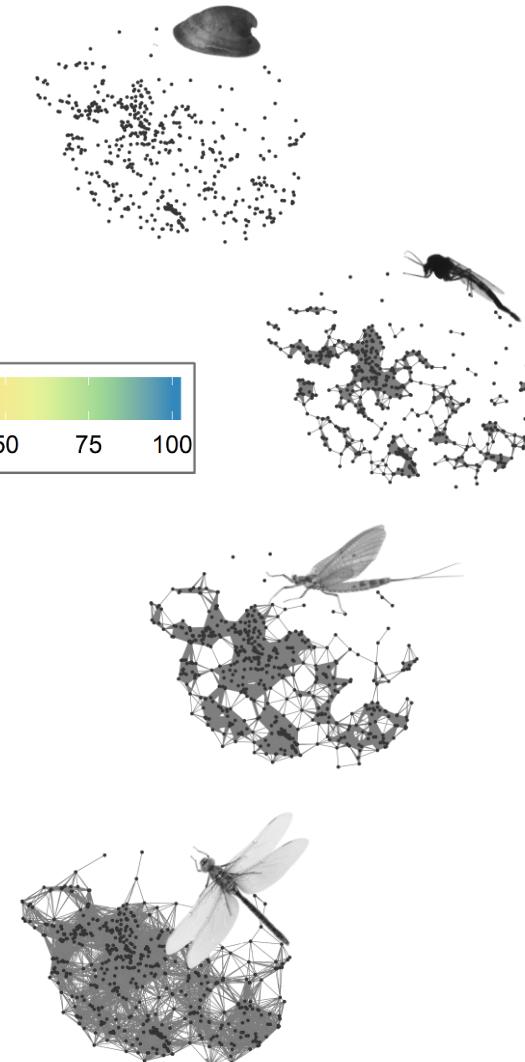
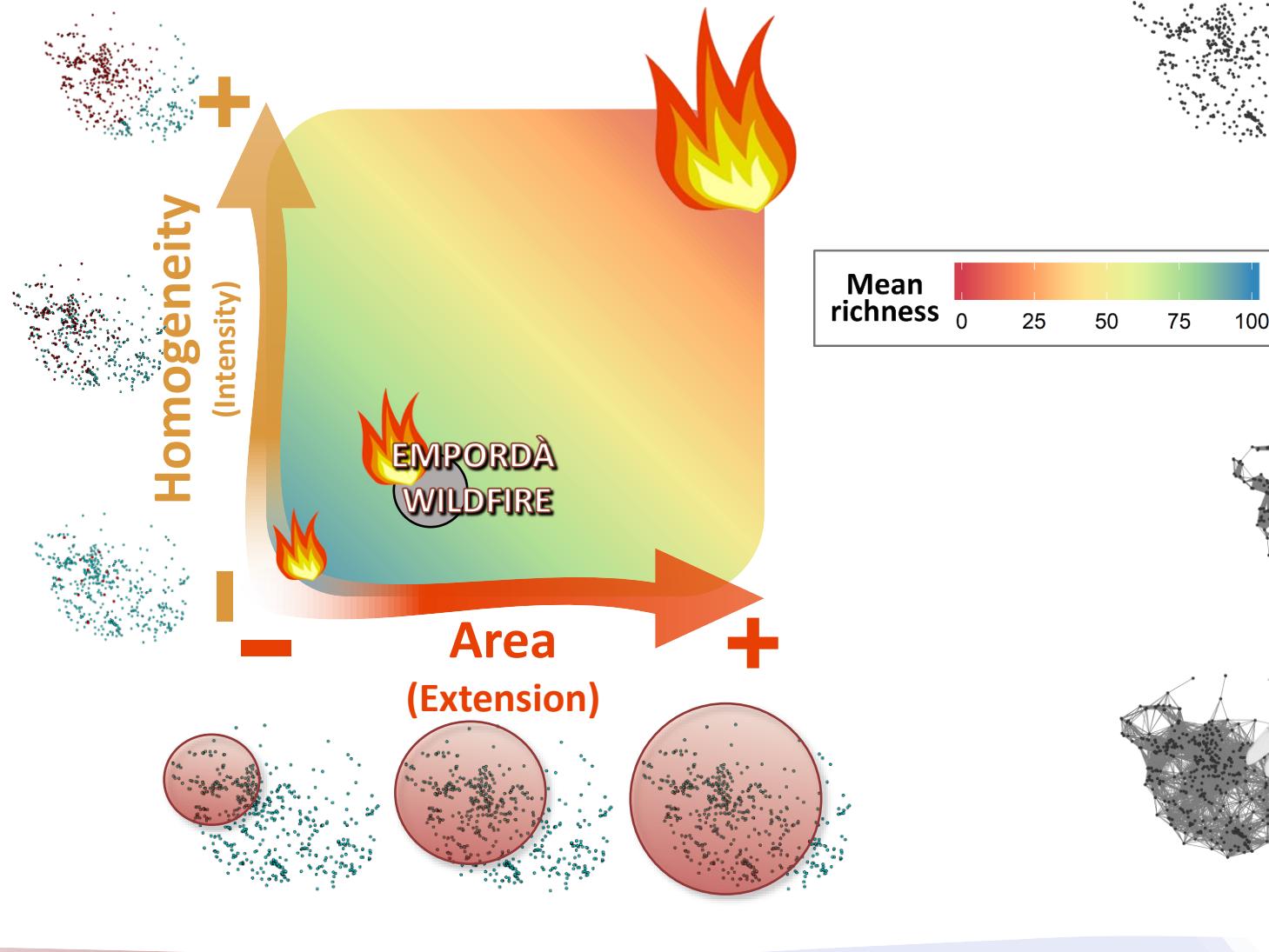


RESULTS and DISCUSSION

@david_cunillera

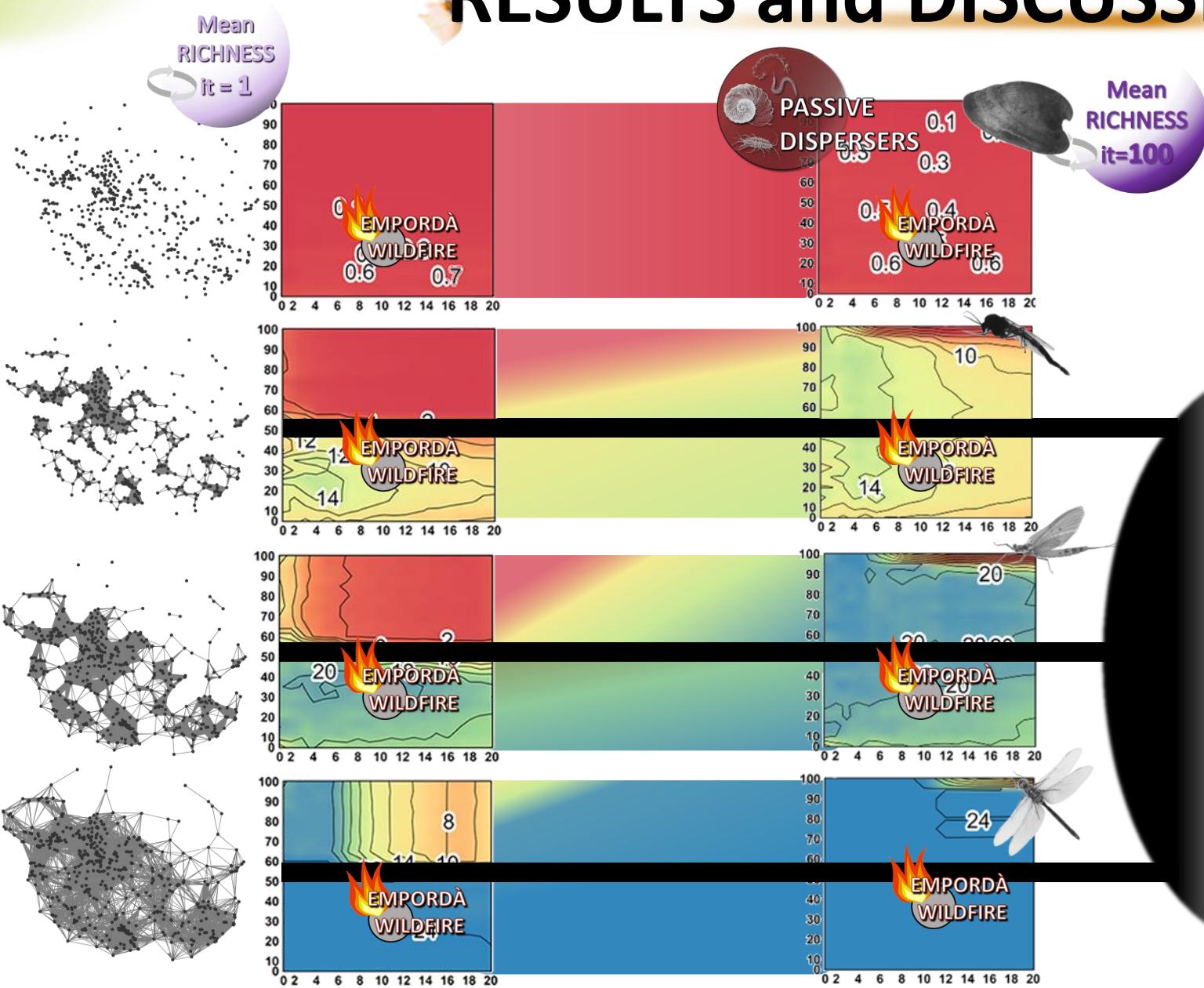


400 Simulated wildfires



RESULTS and DISCUSSION

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EMPORDÀ WILDFIRE
Original wildfire

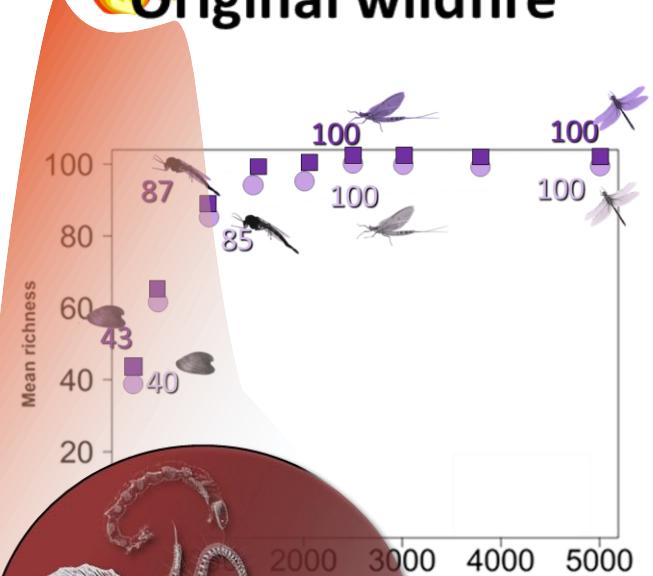
50-60%
Homogeneity
(Intensity)

CONCLUSIONS

@david_cunillera



EMPORDÀ WILDFIRE Original wildfire



PASSIVE
DISPERSERS
EMPIRICALLY

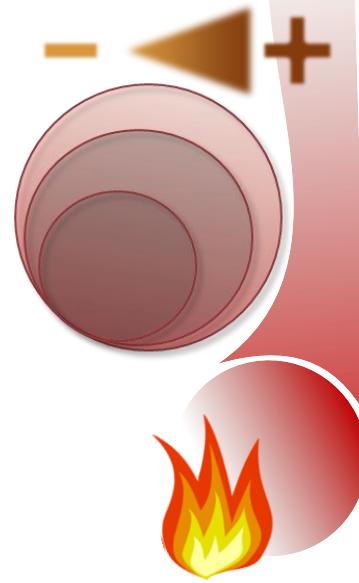


FAKE FIRES 400 Simulated wildfires



LANDSCAPE SCALE

Wildfire regime

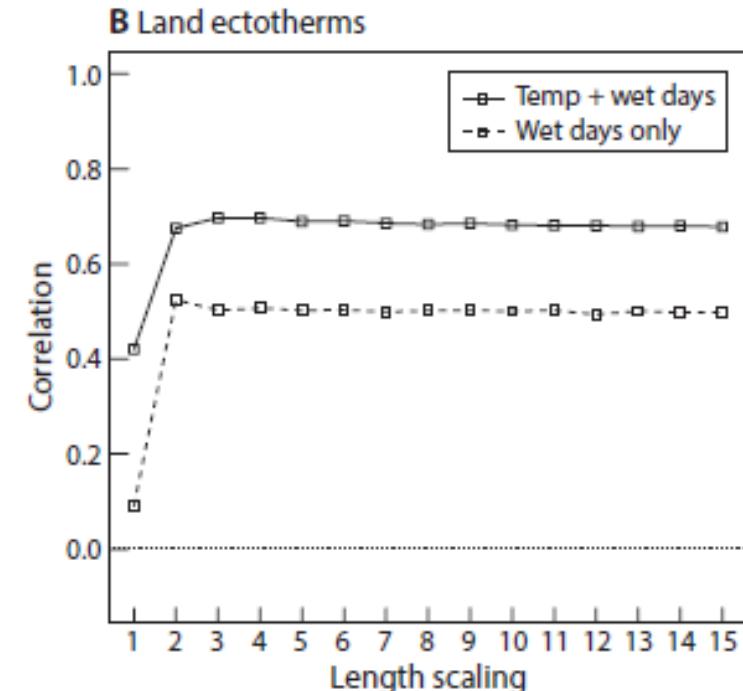
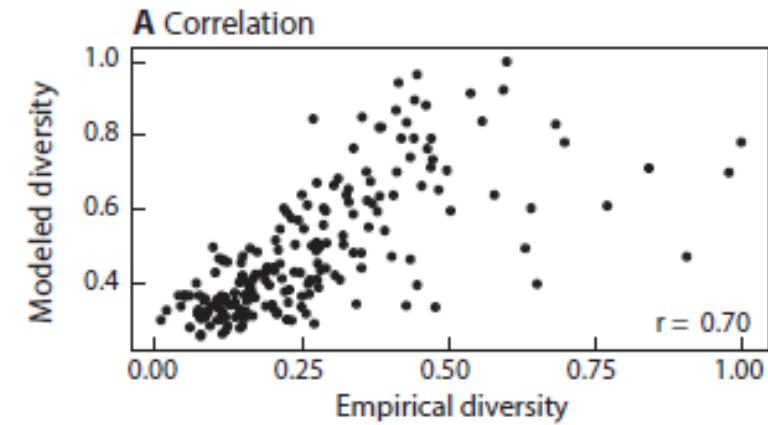
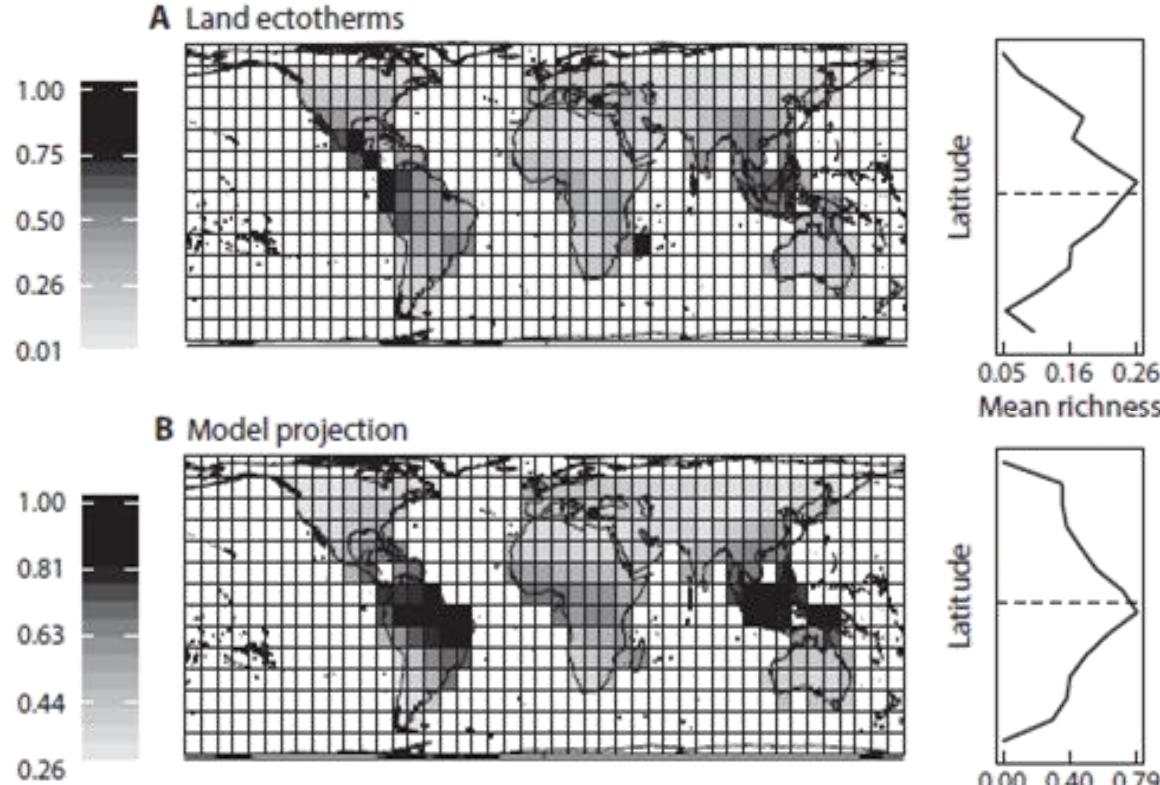


FUTURE SCENARIOS



3. Fake metacommunities to unfold real dynamics

Worm, B., and D. P. Tittensor. 2018. A Theory of Global Biodiversity. Princeton University Press.



*Metabolic Theory
Habitat Area and Productivity
Including Temperature Niches*





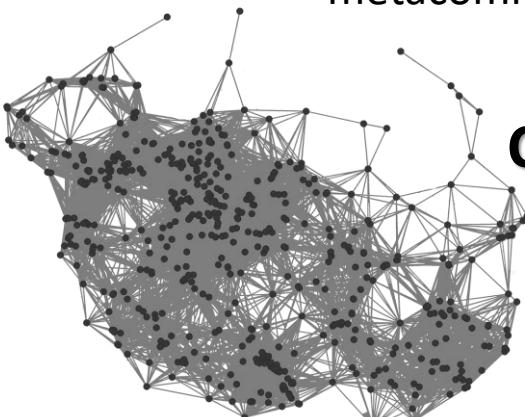
3. Fake metacommunities to unfold real dynamics

Simulation models

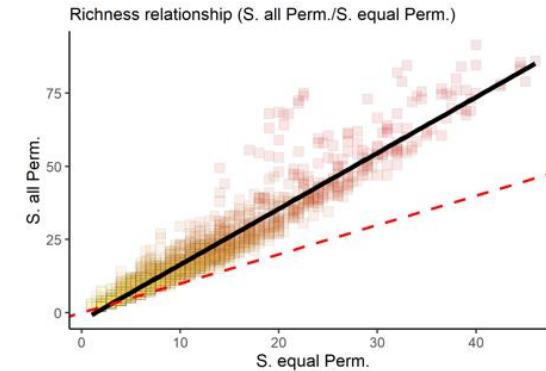
Landscape relevance in determining metacommunity response

Limitations and assumptions that must be considered

Useful insights to better understand metacommunity dynamics



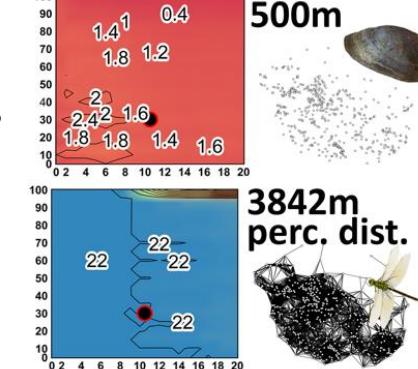
Coalescent + lottery biodiversity model



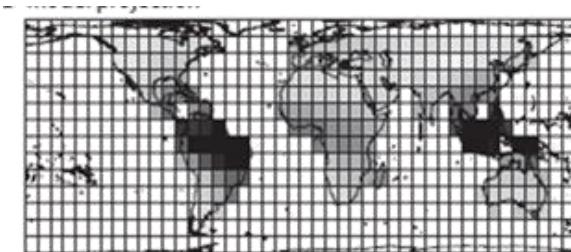
Waterscape

Resilience

Mean richness at T100



Global BID patterns





4. What shall we do with the “drunken sailors”?

Assessing coastscape structure

Threshold distance
Dispersal ability

SCALE

Coalescent + lottery
biodiversity model

