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# WHAT IS A PATCH ?

## Improving spatially explicit individual-based simulations by dividing continuous habitat patches

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### 1 Context

#### Main goal

Simulate red squirrel population dynamics, including dispersal, using a spatially explicit individual-based model



#### Problem encountered

With usual habitat patch definition (contiguous sets of habitat cells) simulated movement patterns are not realistic

→ No dispersal within large contiguous forested areas

#### Question

How does a more species-specific definition of habitat patches modify simulation outputs in terms of dispersal and population size?

### 2 Methods

Spatially-explicit individual-based model: **RangeShiftR**



#### Simulations

- 100 years
- 10 replications
- literature-based demographic parameters
- step-by-step dispersal based on landscape resistance (SMS)

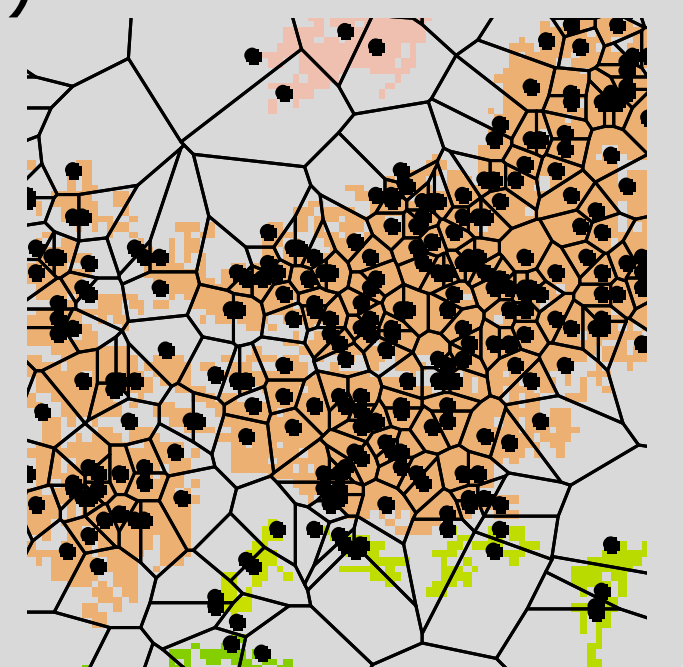
#### Study area

- 16x16 km area in southern France, Alpilles mountains

#### Patch cutting

- random point sampling + Voronoi tessellation
- To get patch size close to red squirrel home range size

Principle of tessellation and patch cutting on a part of the map



### 3 Results

#### Patch size comparison

% of patches with an area within the range of a squirrel's home range:

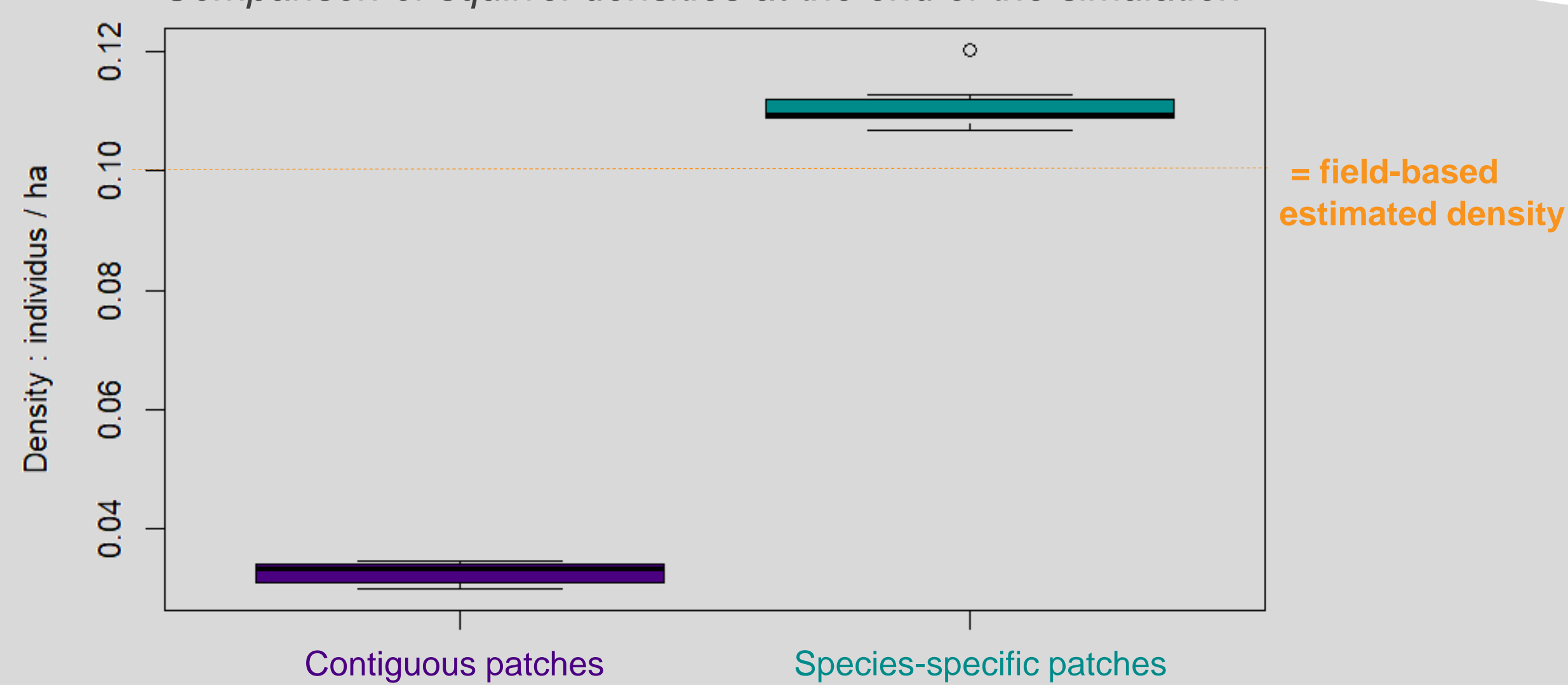
Contiguous patches: **31%**

vs

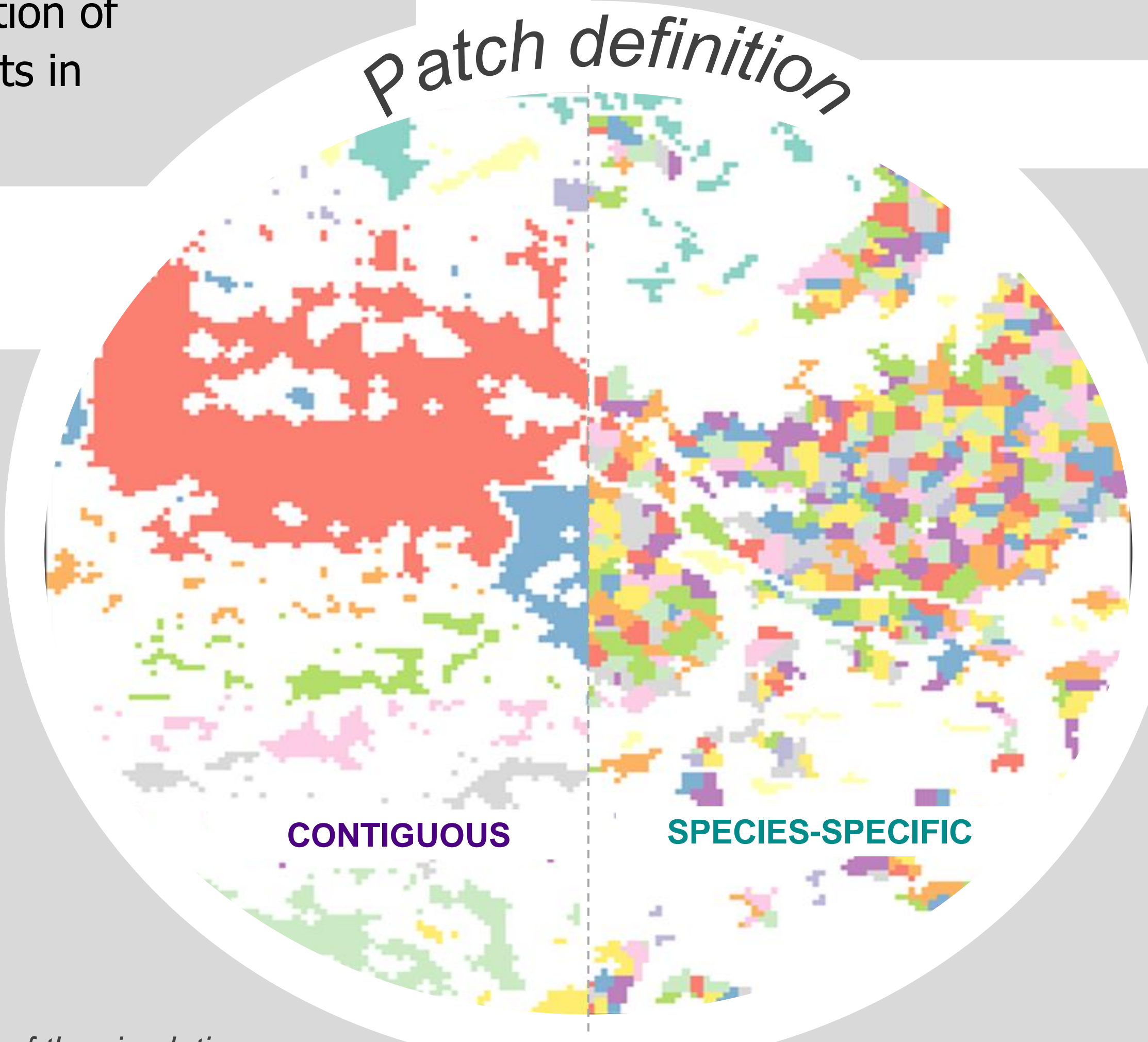
Species-specific patches: **93%**

#### Squirrel density at year 100

Comparison of squirrel densities at the end of the simulation

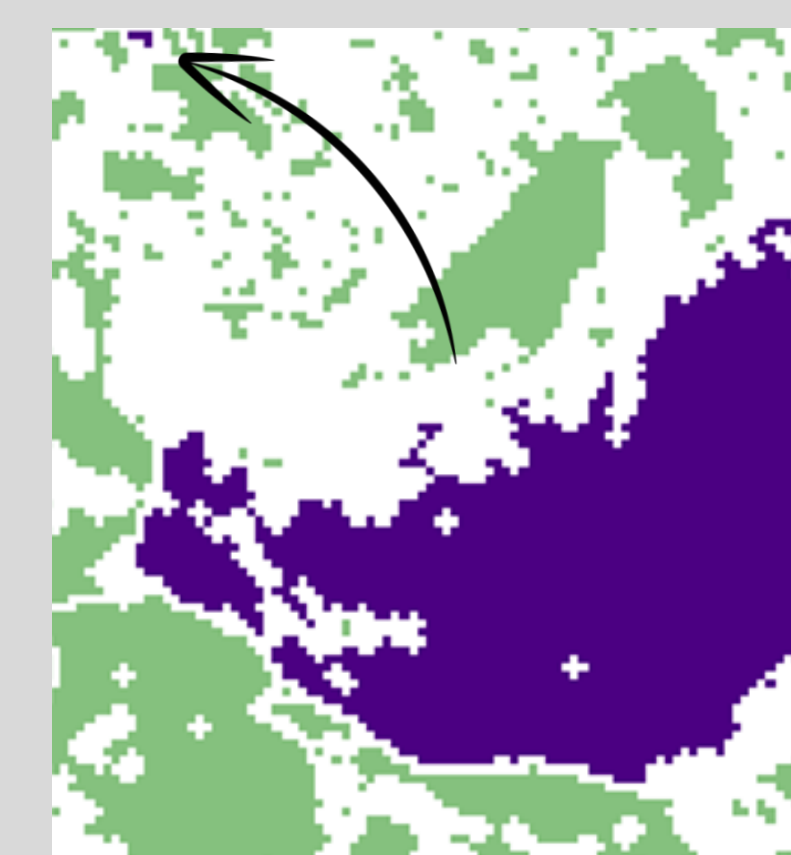


→ When patches are defined according to the species' home range, the density predicted by the simulation is very close to the expected value

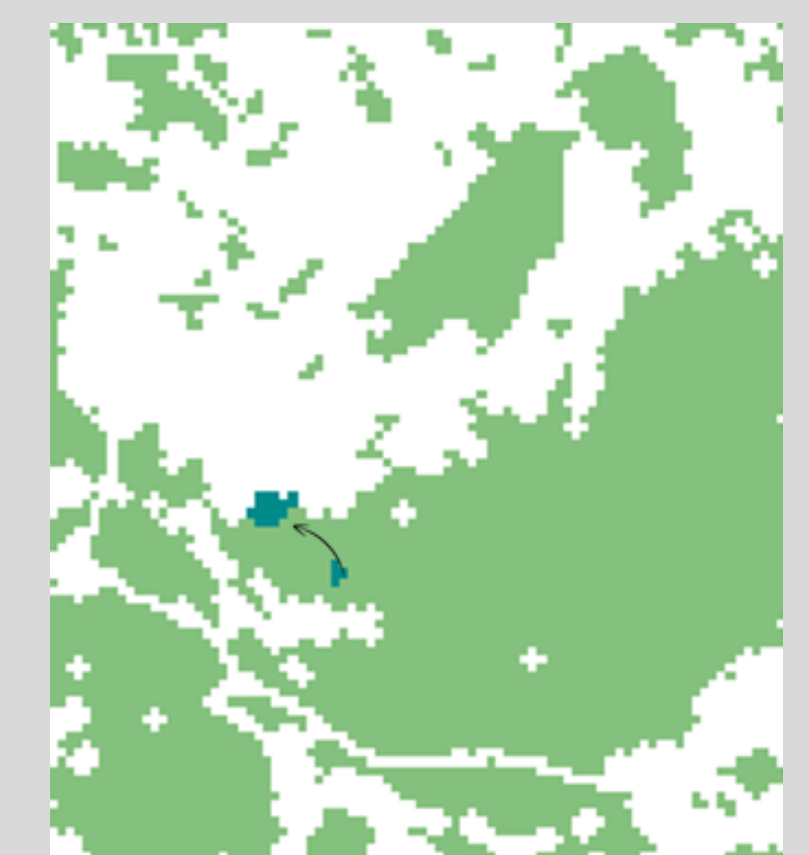


#### Squirrel dispersal

Maps: examples of natal and arrival patches for one individual (cropped map)



Contiguous patches



Species-specific patches

Dispersal success rate

**6.99%**  
(± 0.37%)

**19.73%**  
(± 3.15%)

Median dispersal distance

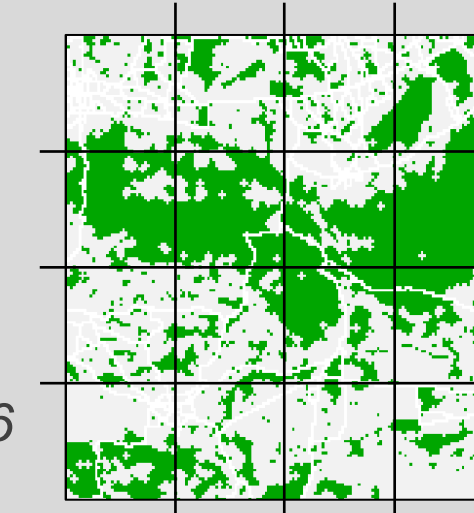
**3 808.91 m**  
(± 136.11m)

**388.59 m**  
(± 47.13 m)

% dispersal from a zone to another

**74.9%**  
(± 2%)

**23%**  
(± 5.5%)



Landscape divided in 16 zones with equal areas

→ When patches area is similar to squirrel home range size, predicted dispersal statistics are closer to estimates from literature

### 4 Conclusions

- AIM:** Patch area closer to squirrels home range
- RESULT 1:** Abundance closer to field-based estimates
- RESULT 2:** Dispersal success rate and median dispersal distance closer to literature data
- NEXT STEP:** Investigate **consequences** on genetic outputs

#### References

Bocedi G, Palmer SCF, Pe'er G, Heikkinen RK, Matsinos YG, Watts K, Travis JMJ (2014) RangeShifter: A Platform for Modelling Spatial Eco-Evolutionary Dynamics and Species' Responses to Environmental Changes. *Methods in Ecology and Evolution* 5: 388–396. <https://doi.org/10.1111/2041-210X.12162>.  
Bocedi G, Palmer SCF, Malchow AK, Zurell D, Watts K, Travis JMJ (2020) RangeShifter 2.0: An extended and enhanced platform for modelling spatial eco-evolutionary dynamics and species' responses to environmental changes. *bioRxiv* 2020.11.26.400119. <https://doi.org/10.1101/2020.11.26.400119>



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