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► **To cite this version:**

Mailys Queru, Cécile H. Albert, Aurélie Coulon. What is a patch?. BES, Dec 2023, Belfast (Northern Ireland), Ireland. 2023. hal-04871016

HAL Id: hal-04871016

<https://amu.hal.science/hal-04871016v1>

Submitted on 7 Jan 2025

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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)

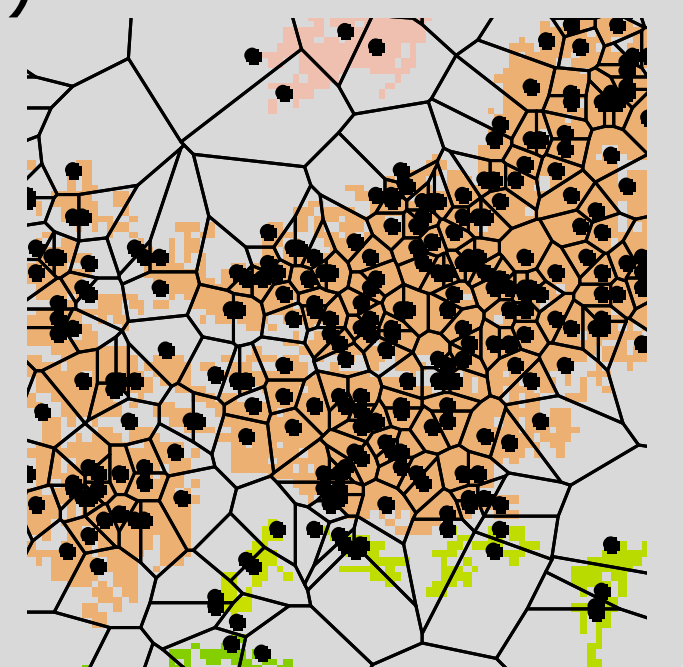
Study area

- 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

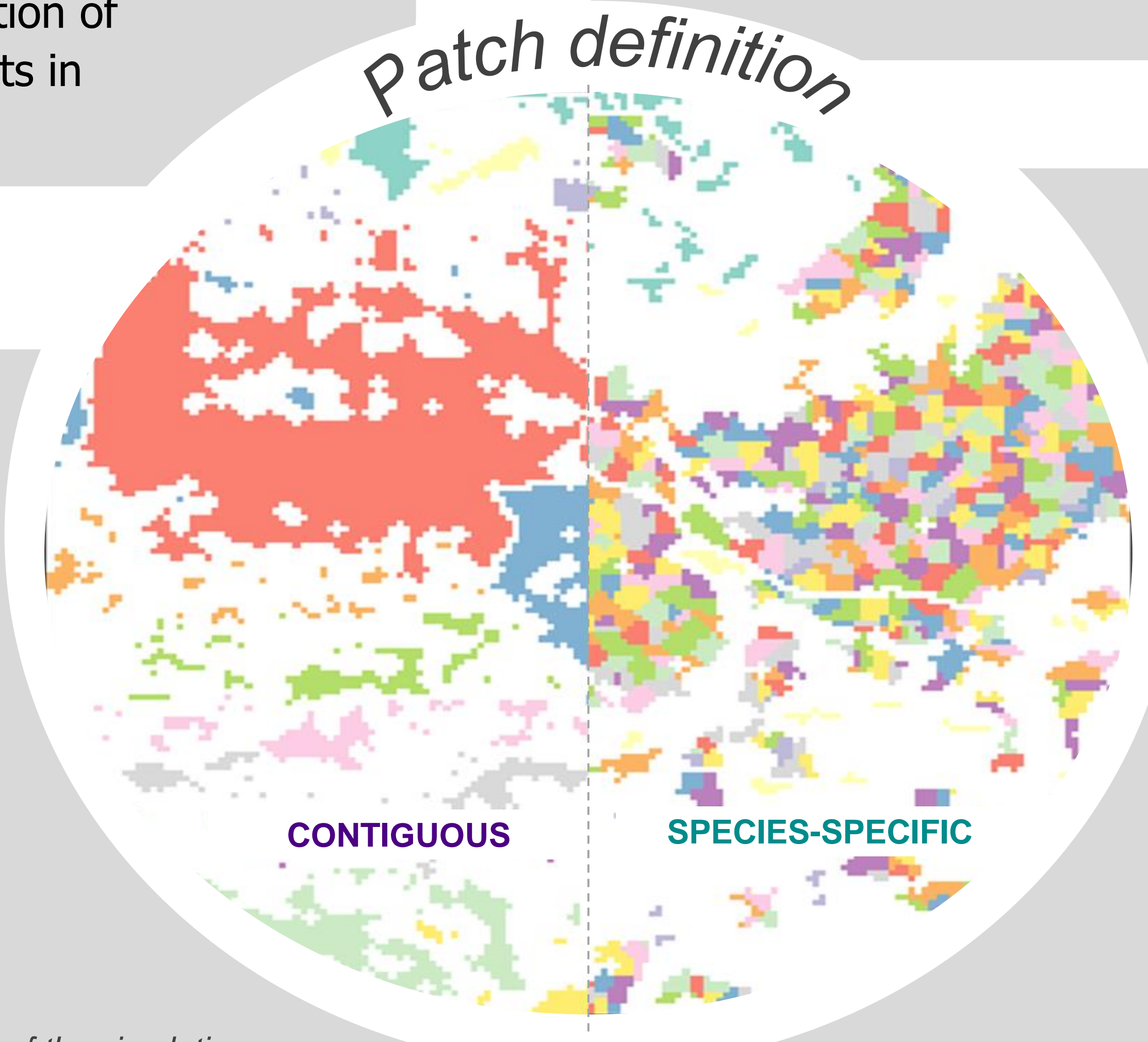
Patch size comparison

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

Contiguous patches: **31%**

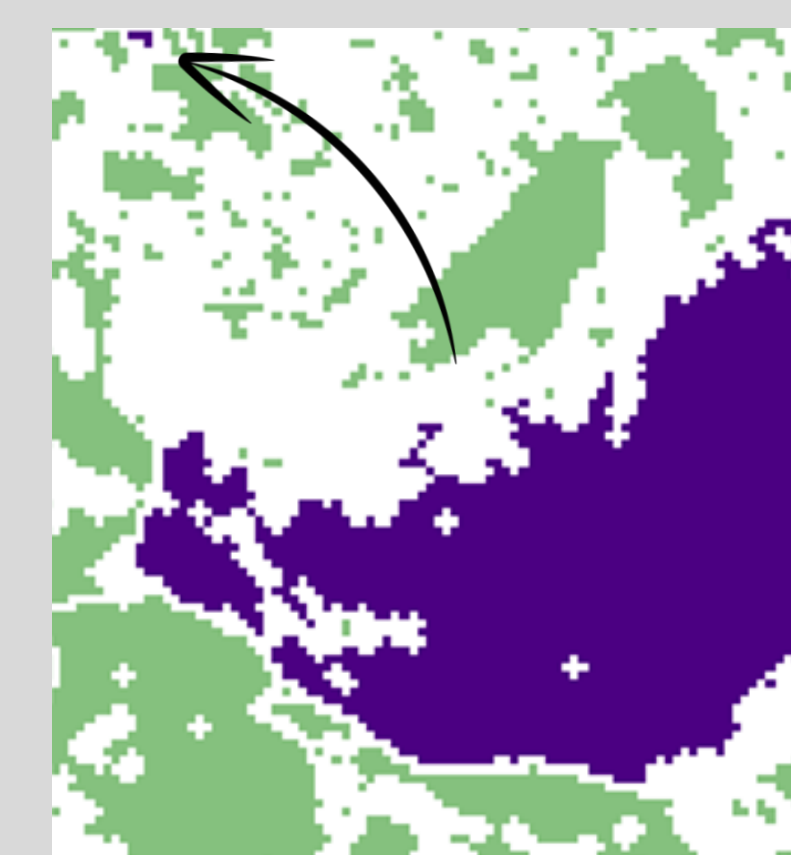
vs

Species-specific patches: **93%**



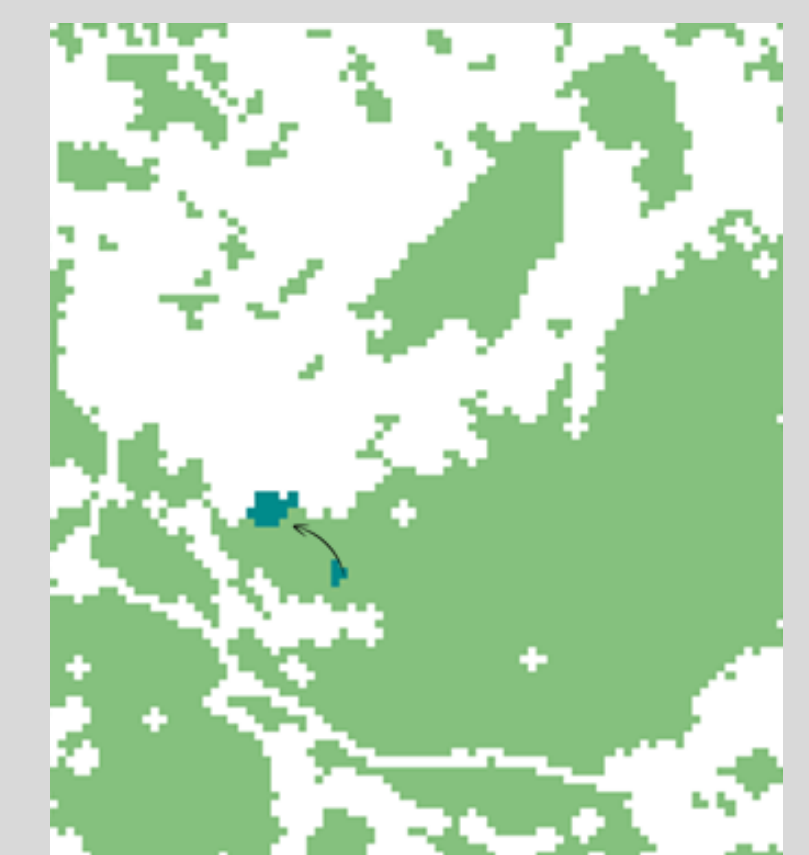
Squirrel dispersal

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



■ Natal and arrival patches ■ Habitat

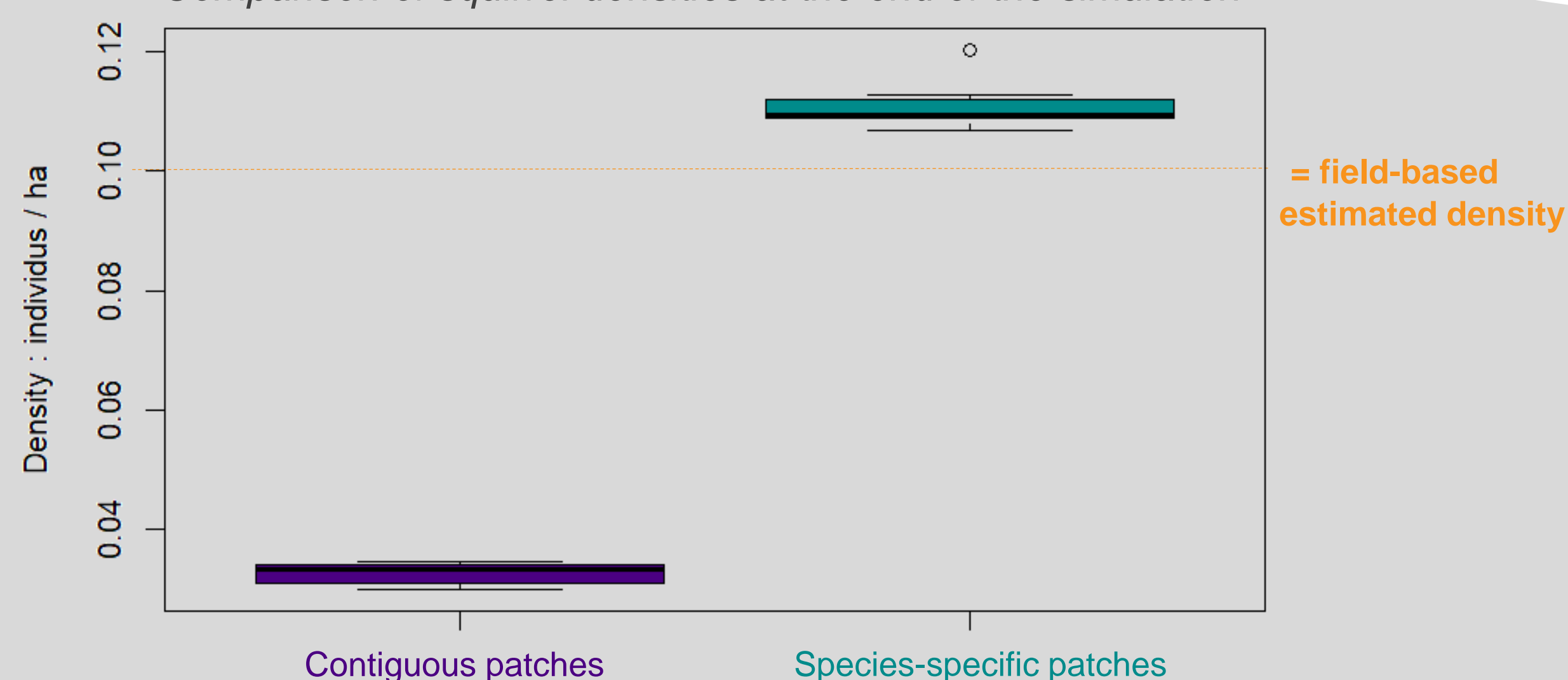
Contiguous patches



Species-specific patches

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

Dispersal success rate

6.99%
(± 0.37%)

19.73%
(± 3.15%)

Median dispersal distance

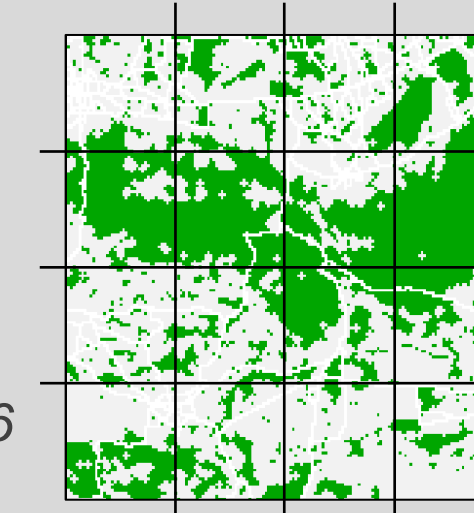
3 808.91 m
(± 136.11m)

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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