EGU General Assembly 2022

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Unexpected movements of earthworms between tree rows and crop alleys in a Mediterranean agroforestry site

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Context

- In alley cropping agroforestry, tree rows and their associated understory vegetation strip alternate with crop alleys
- These tree rows host higher densities of soil invertebrates than crop alleys, especially species sensitive to soil disturbance and bare soil
- A spillover of the organisms hosted in the tree row is expected at favorable seasons

Boinot et al., 2019
Cardinael et al, 2019
Pardon et al, 2019
D'Hervilly et al., 2020, 2022

Aims

1) Investigate earthworm spillover from the tree row to the crop alley

2) Propose a method to record earthworm fluxes between habitats at small scale

Site

walnuts

Mediterranean climate

Silty soil

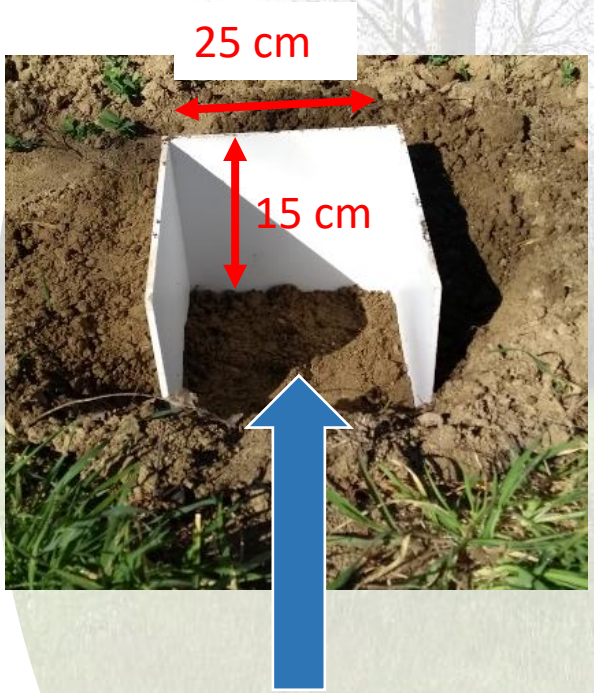
15,4 °C

658 mm

Spontaneous understory vegetation

Pea, ploughing, pesticides and fertilization

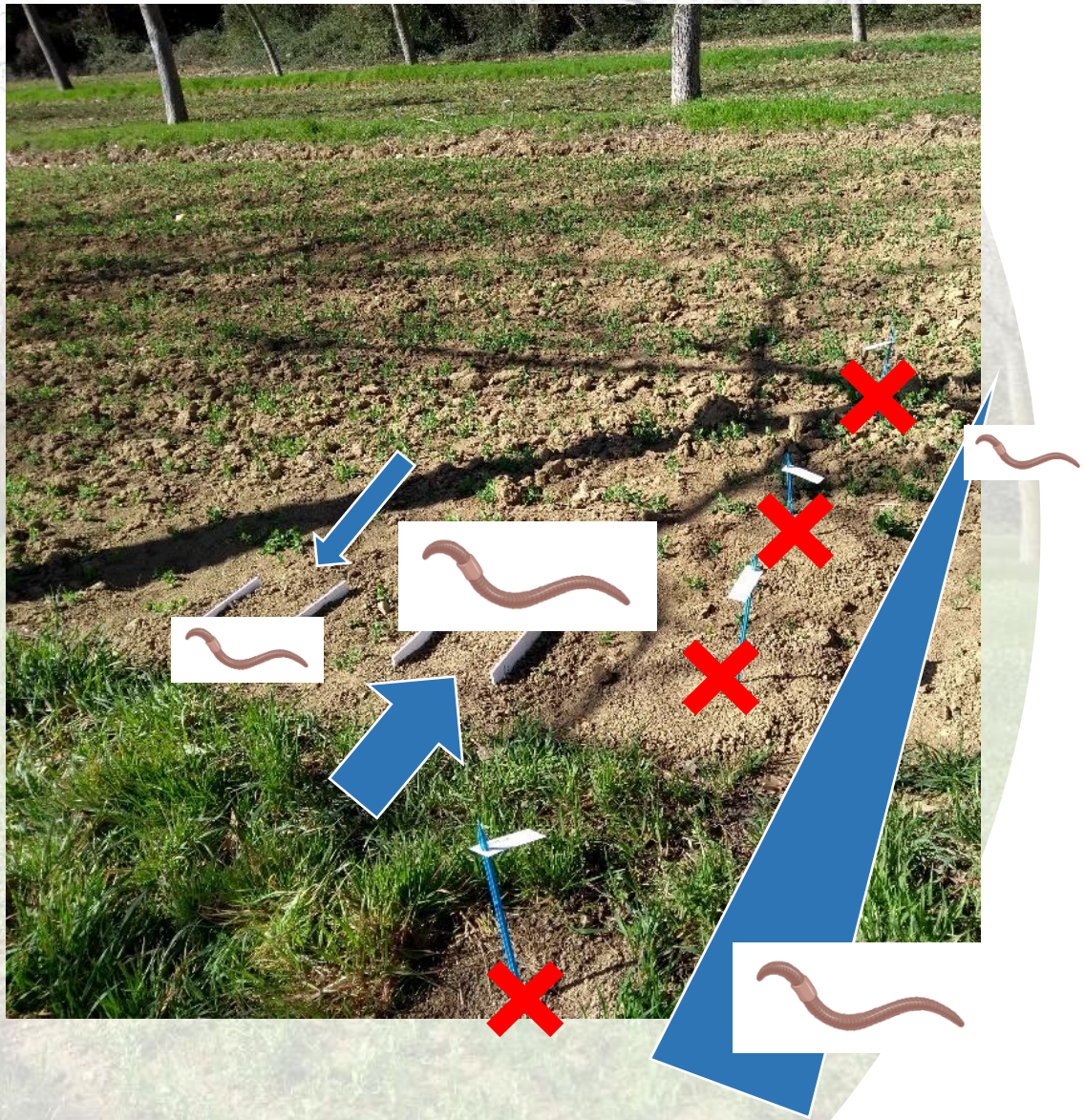
Methods



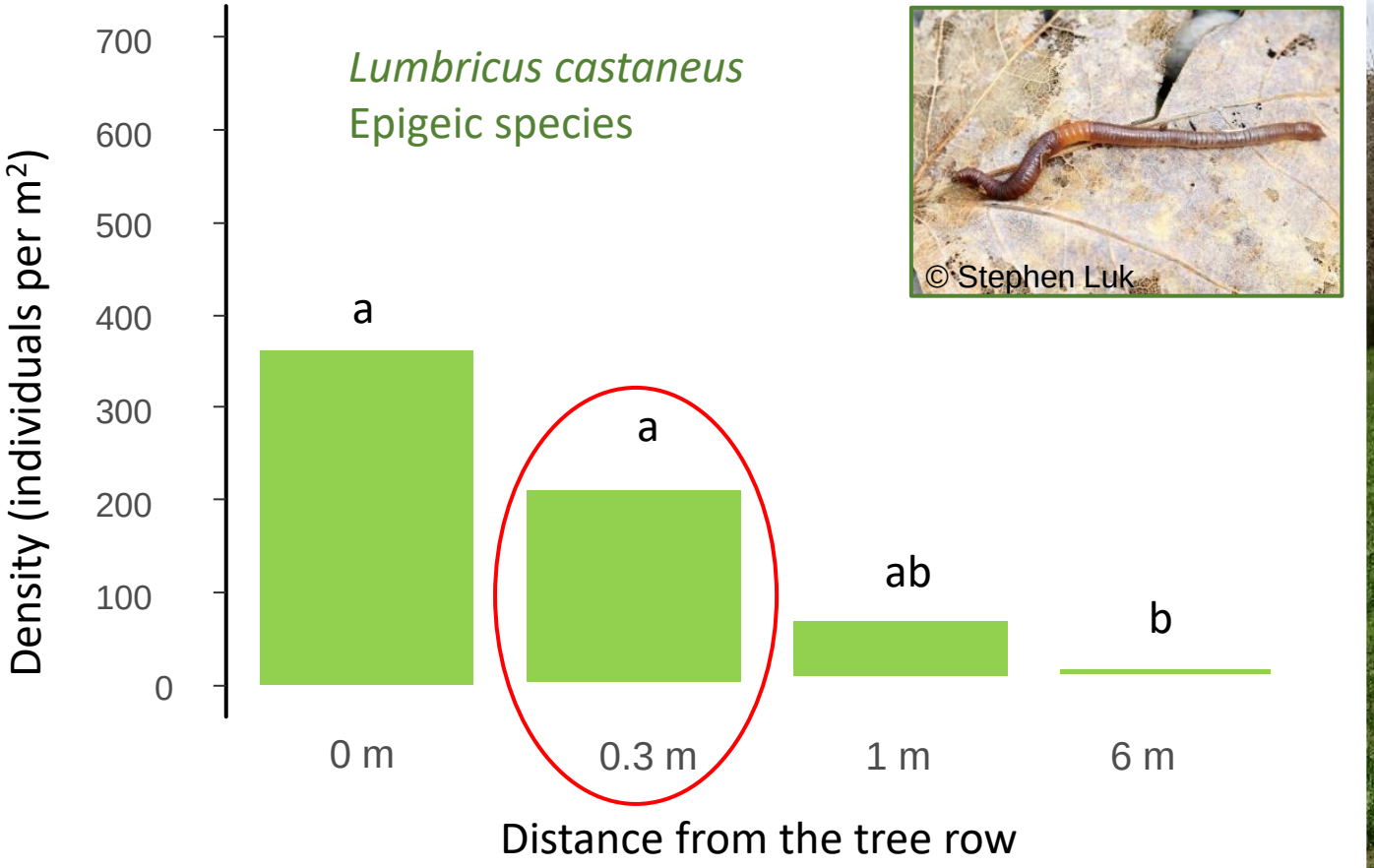
- We designed oriented traps, filled with soil, that allowed earthworm entrance from one side only
- These traps were open towards the tree row or towards the crop alley, and placed at 30 cm from the tree row border
- Traps were set up in March and removed in May (spring), 10 replicates
- Earthworms were also sampled at different distances from the tree row in undisturbed soil cores of 25*25*30 cm depth

Hypotheses

- Due to spillover from the tree row, more earthworms will enter the traps open towards the tree row
- There is a decreasing gradient of earthworm density from the tree row to the middle of the crop alley

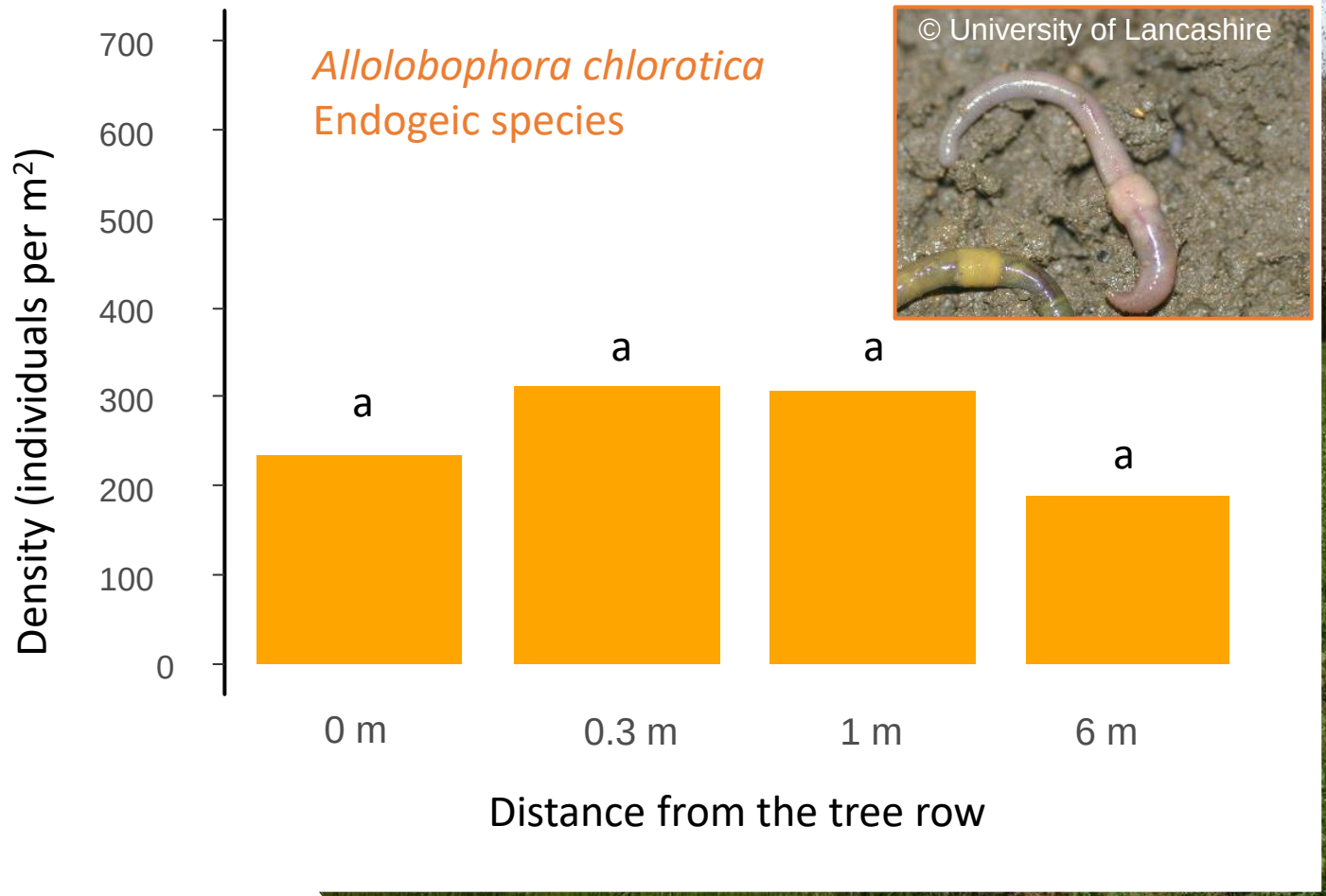


Earthworm distribution in March



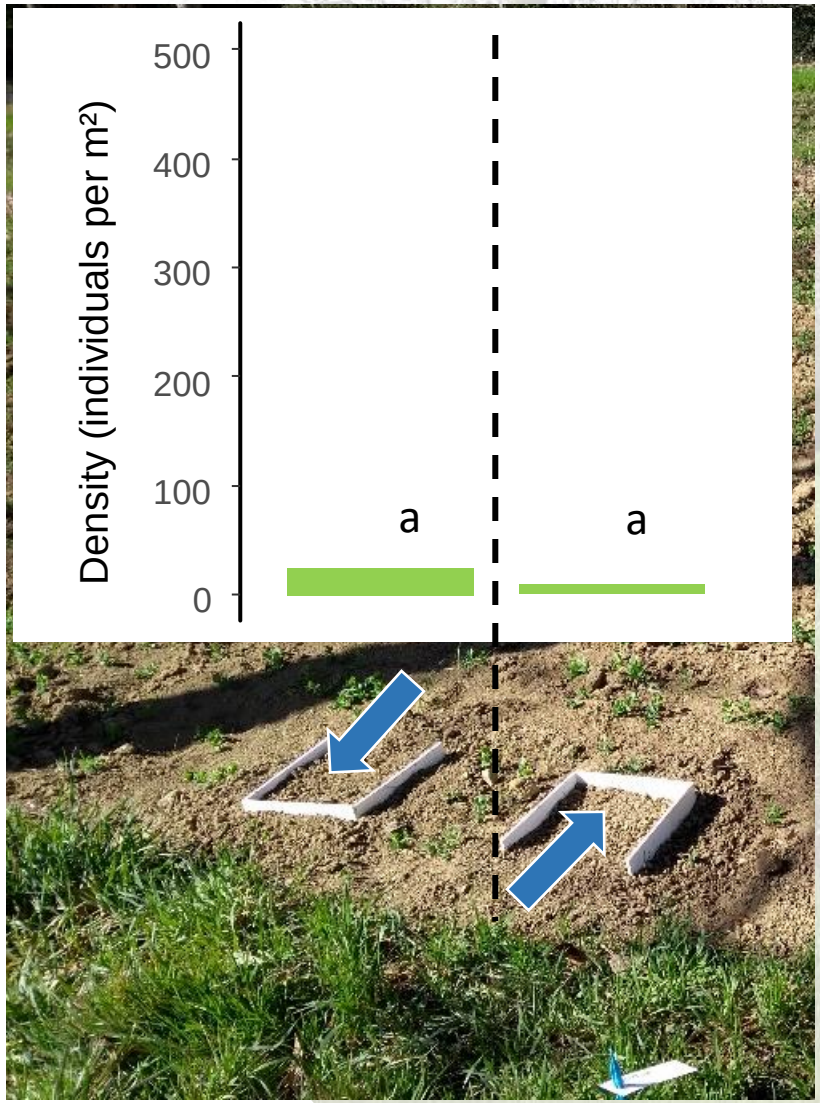
- Epigeic live and feed on litter at the soil surface, they are negatively impacted by bare soil in the crop alley
- They are however present in the vicinity of the tree row, especially at the level of the oriented traps

Earthworm distribution in March



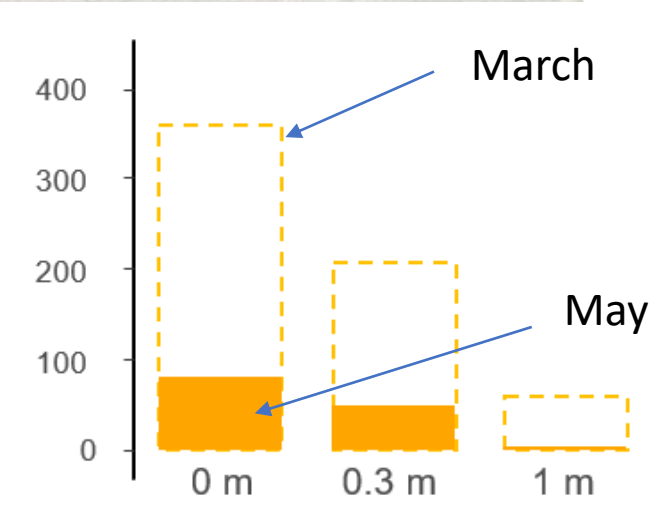
- Endogeic species live and feed in the soil
- *A. chlorotica* is a plastic species, and is positively impacted by soil tillage in the crop alley

Earthworm in traps



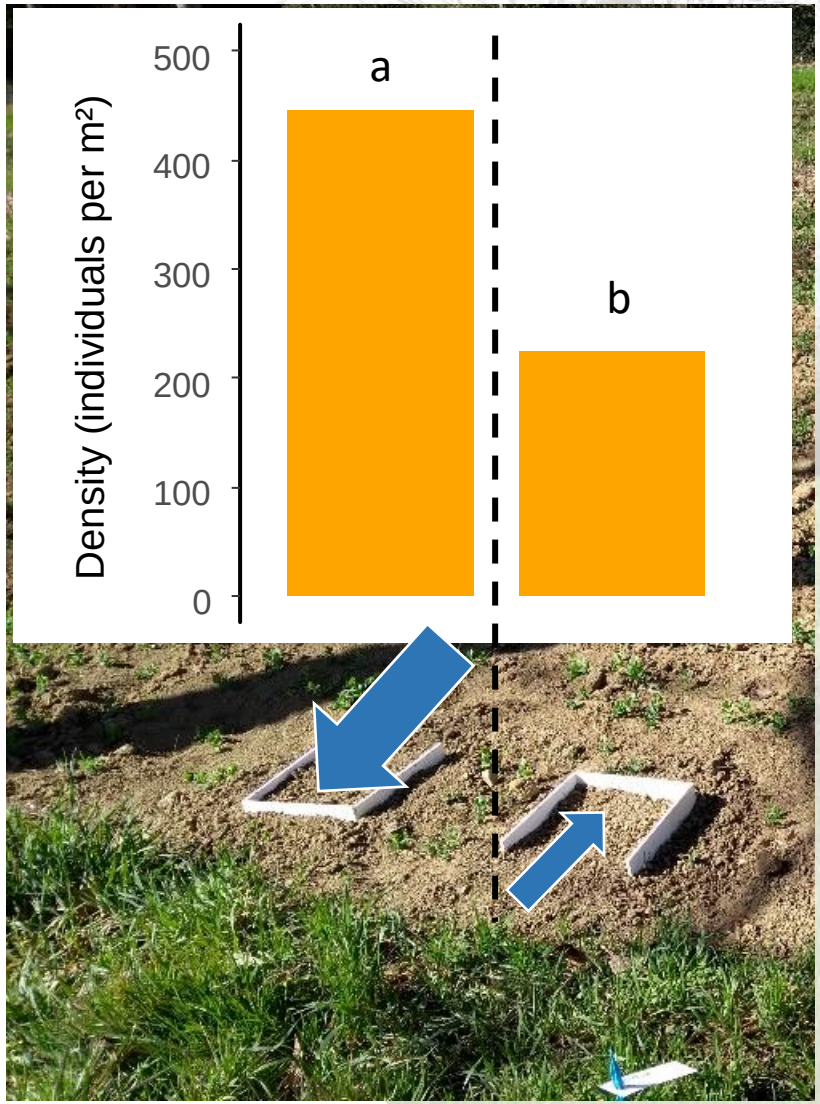
Lumbricus castaneus
Epigeic species

- Traps not effective to detect epigeic fluxes?
- Not the best season to investigate epigeic fluxes (too dry)? High mortality observed between the beginning and the end of the experiment



- The distribution of epigeic in the plot suggests a spillover at other seasons

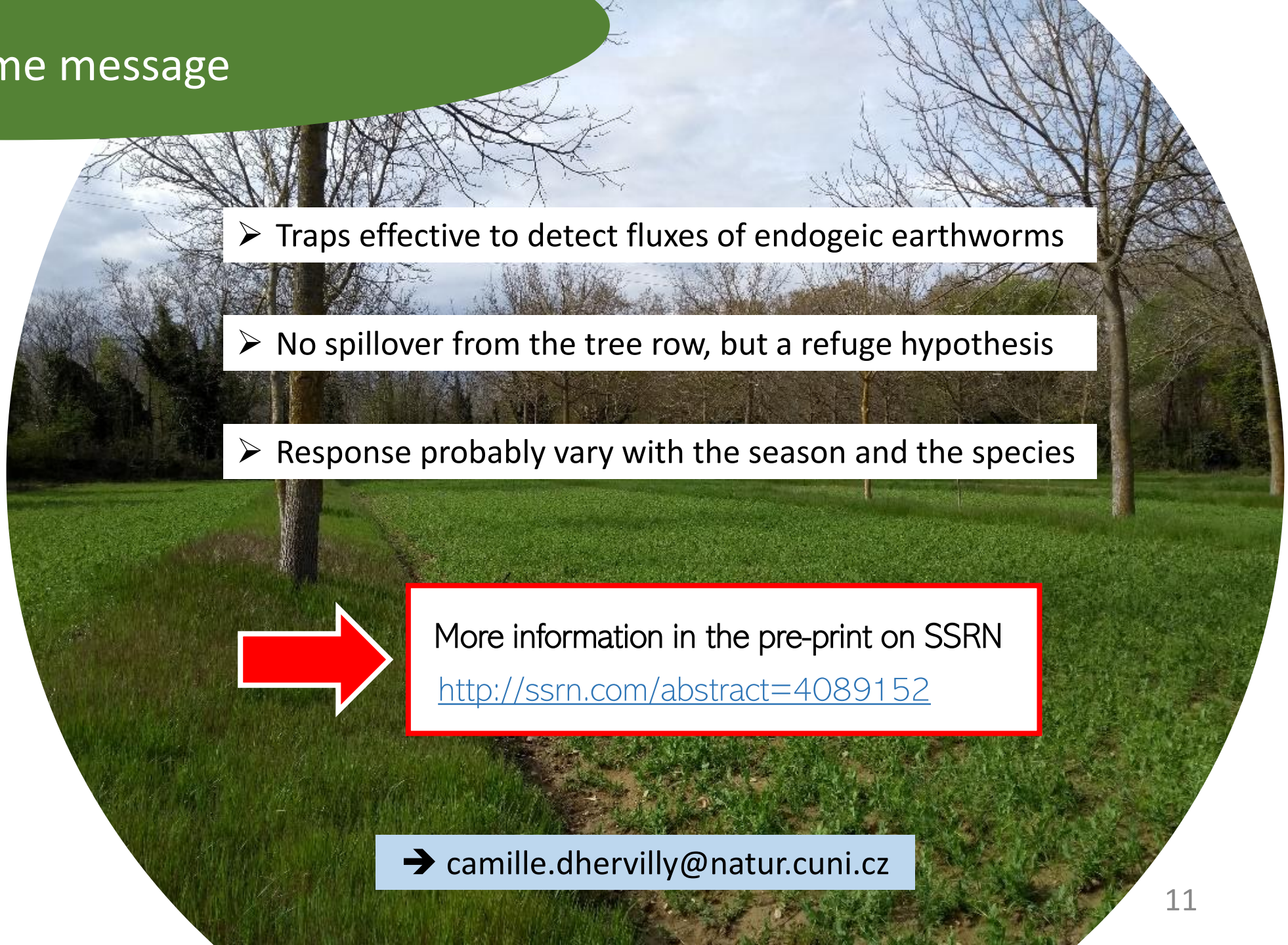
Earthworm in traps



Allolobophora chlorotica
Endogeic species

- No differences in earthworm density between both sides of the traps: active dispersal at stake
- No spillover from the tree row, but fluxes directed towards the tree row
- The tree row could act as a refuge against adverse conditions in the crop alley
- The fluxes could also be directed towards the vicinity of the tree row, where buried litter from tree leaves was found

Take home message



- Traps effective to detect fluxes of endogeic earthworms
- No spillover from the tree row, but a refuge hypothesis
- Response probably vary with the season and the species

More information in the pre-print on SSRN

http://ssrn.com/abstract=4089152

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Thank you for reading!

sustainability

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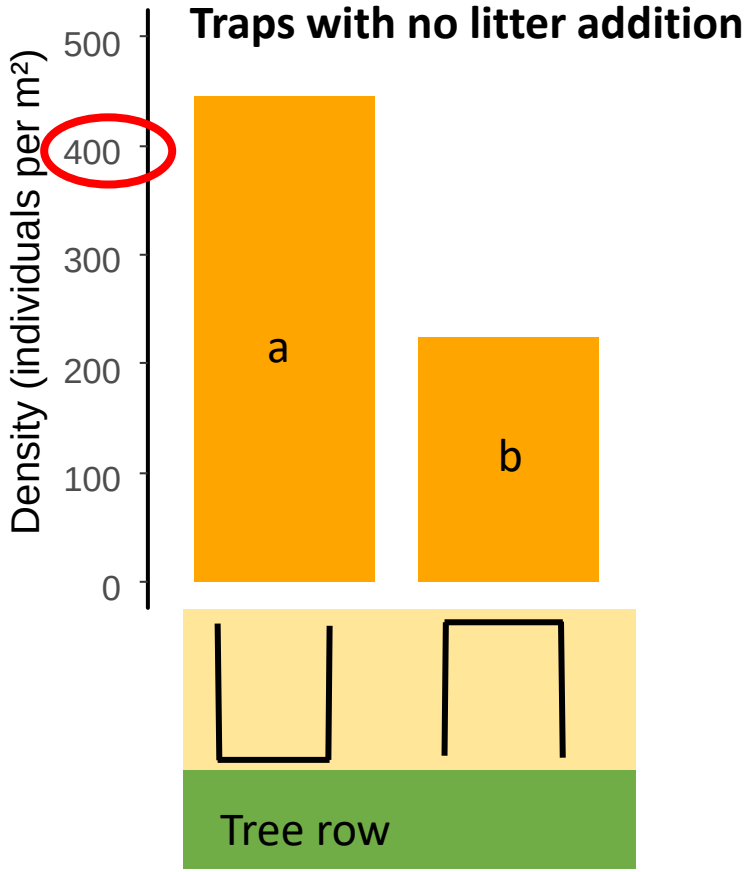
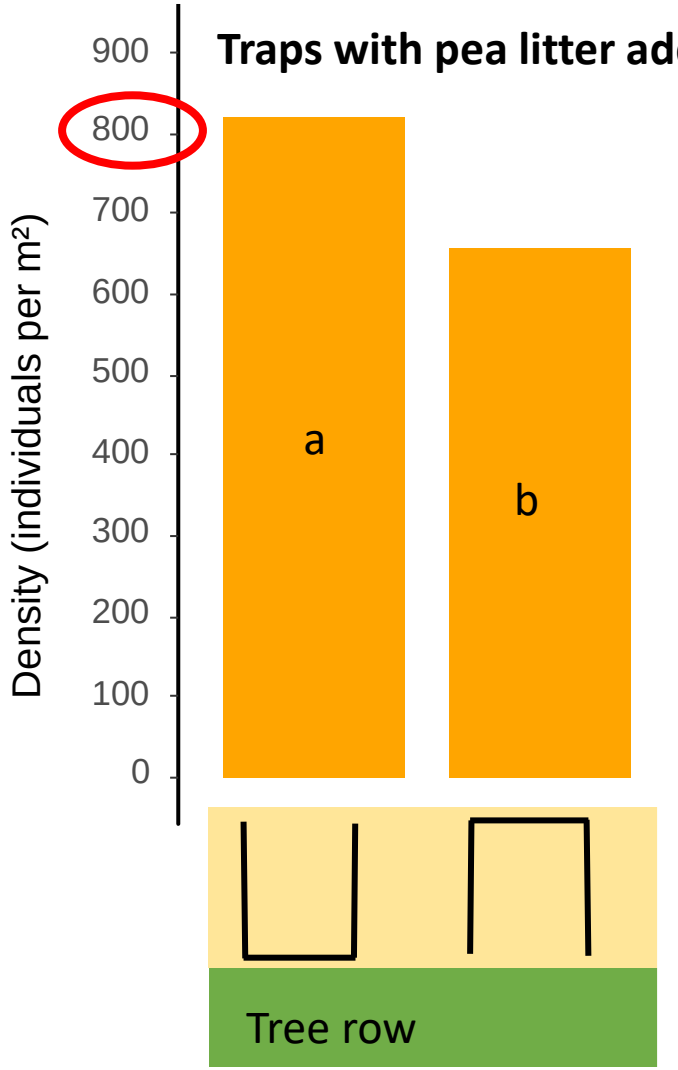
Deadline 15 December 2022

Supplementary information

- We tested the effect of the addition of 100 g of pea litter mixed with the soil in half of the traps
- Decreased the p-value for the effect of trap orientation (could increase the chances to detect fluxes in plots with low earthworm densities)

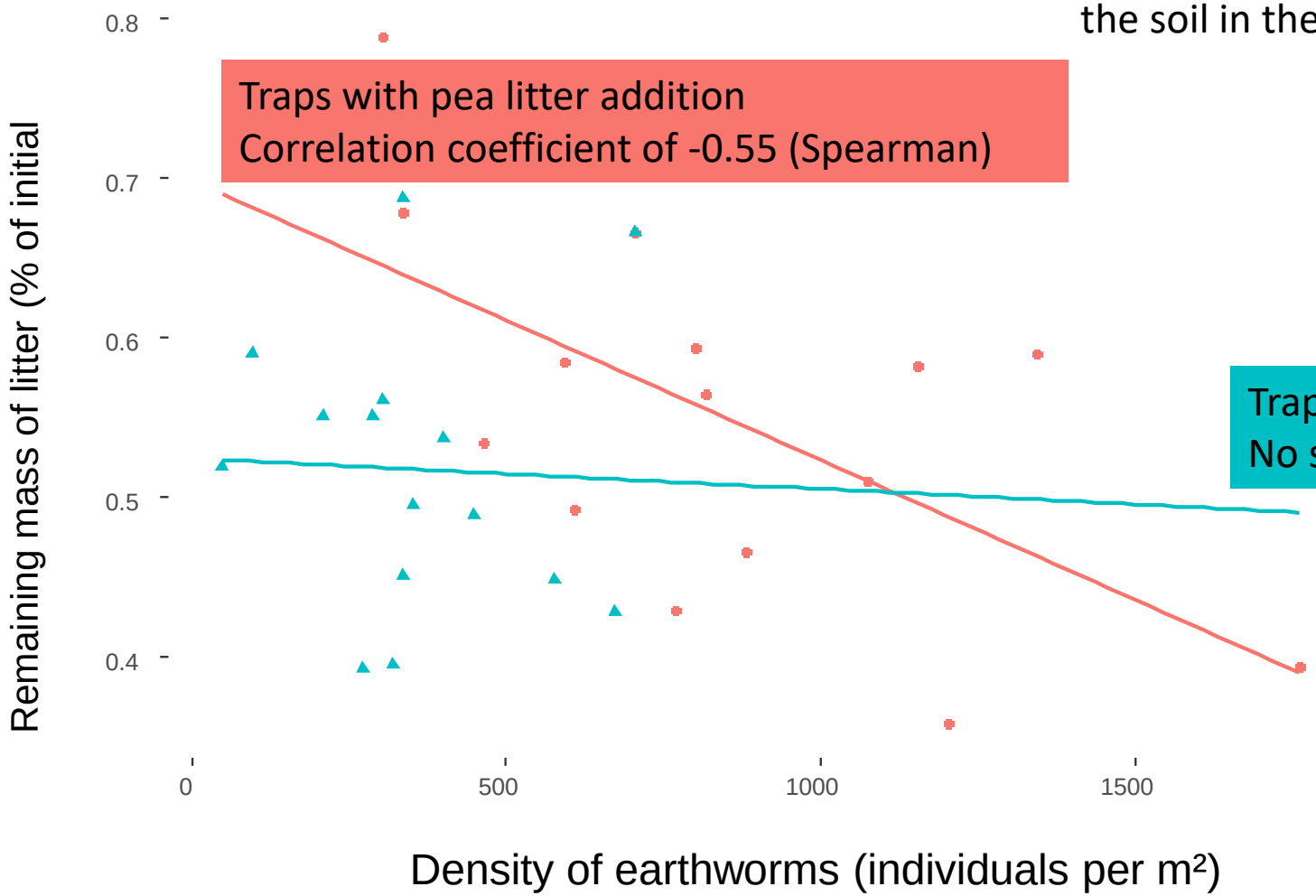




Allolobophora chlorotica
Endogeic species

Supplementary information

- We tested the effect of litter bags addition (pea litter) to detect past earthworm activity in the trap
- Does no allow to detect significant differences with trap orientation
- Correlate with the density of earthworms found in the traps at the end of the experiment only when litter was mixed with the soil in the traps



7 cm deep