Impacts on earthworm urban communities of engineering processes (reconstructed Anthroposoils) and road infrastructures

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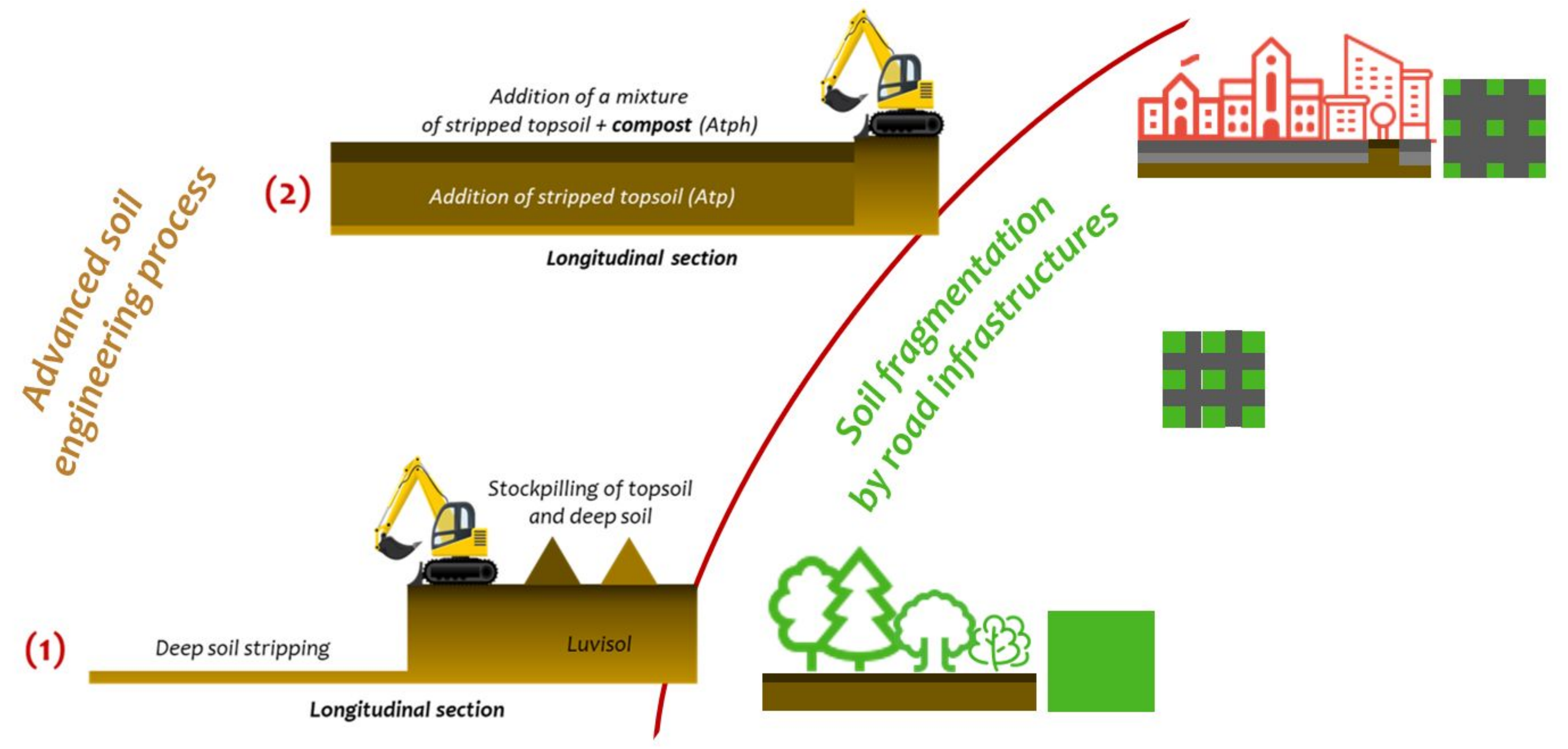
Context & problematics



- Maintaining soil functions is a key issue in urban contexts but can be challenging due to the soil degradation caused by urban development (e.g., soil compaction by construction machinery, soil stripping, accumulation of stones and building materials) mostly due to the expansion of buildings and **road infrastructures** (Craul, 1985; Pavao-Zuckerman, 2008).
- One strategy chosen by urban planners to restore soil functions is to reconstruct soils on the model of natural soils to achieve similar levels of soil functionality thanks to an **advanced soil engineering process** consisting of : **(1)** digging deep trenches in existing urban soils to remove unfavourable material for vegetation growth ; **(2)** filling the trenches with a first layer of topsoil (previously stripped and stockpiled) and a second layer of compost-amended topsoil. The resulting soils are called **reconstructed Anthroposoils** (Lehmann and Stahr, 2007; Maréchal et al., 2021).
- Earthworm communities are well recognized as key actors to improve soil properties and accelerate soil restoration (Scullion and Malik, 2000; Frouz et al., 2006; Boyer and Wratten, 2010). Two problematics can be raised in relation with the advanced soil engineering process and the reconstruction of soils in an urban environment fragmented by roads infrastructure :

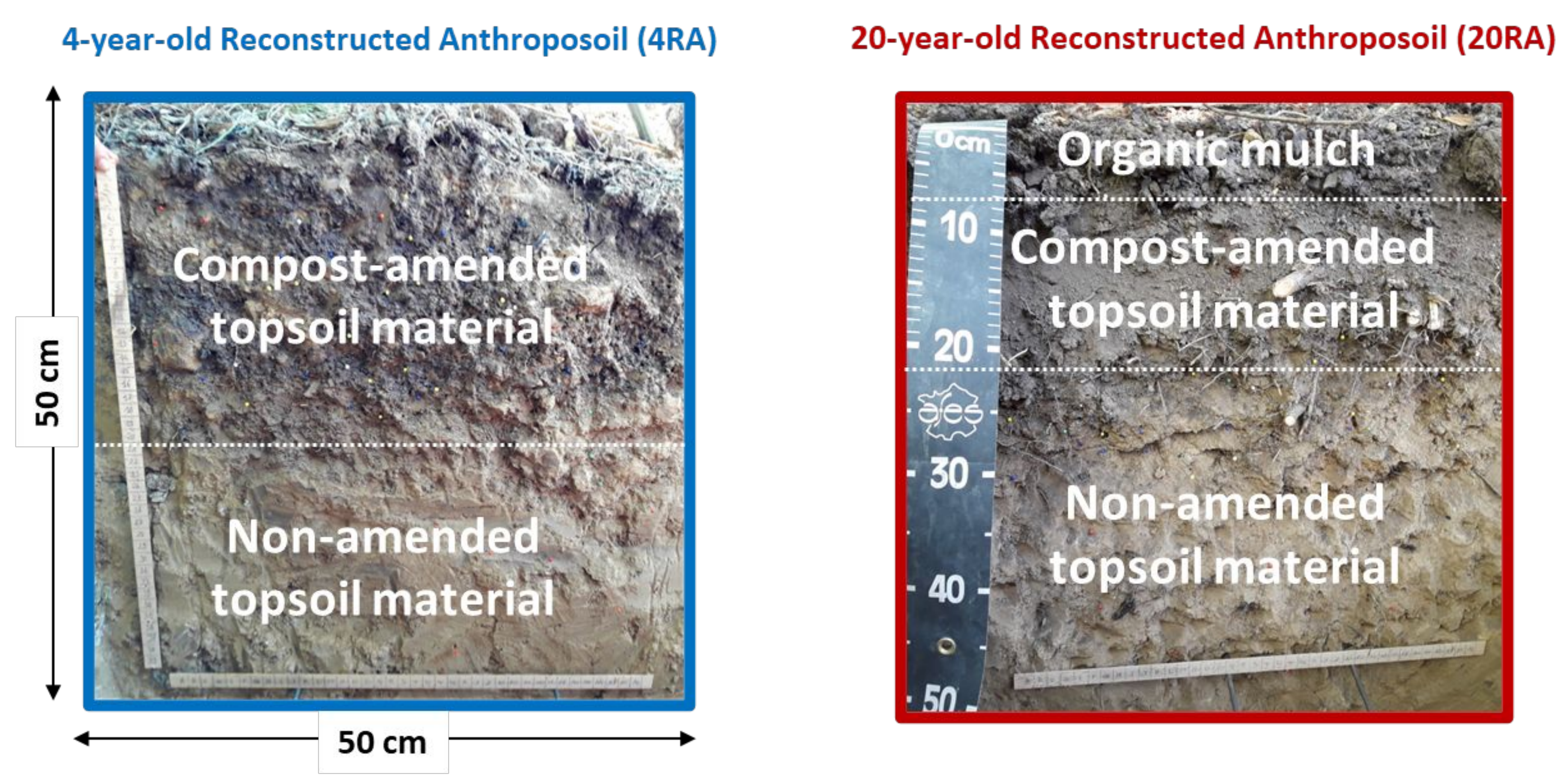
(1) What are the impacts of the advanced soil engineering process leading to reconstructed Anthroposoils on earthworm communities ?

(2) What are the impacts of road infrastructures surrounding or bordering advanced reconstructed soils on earthworm communities ?

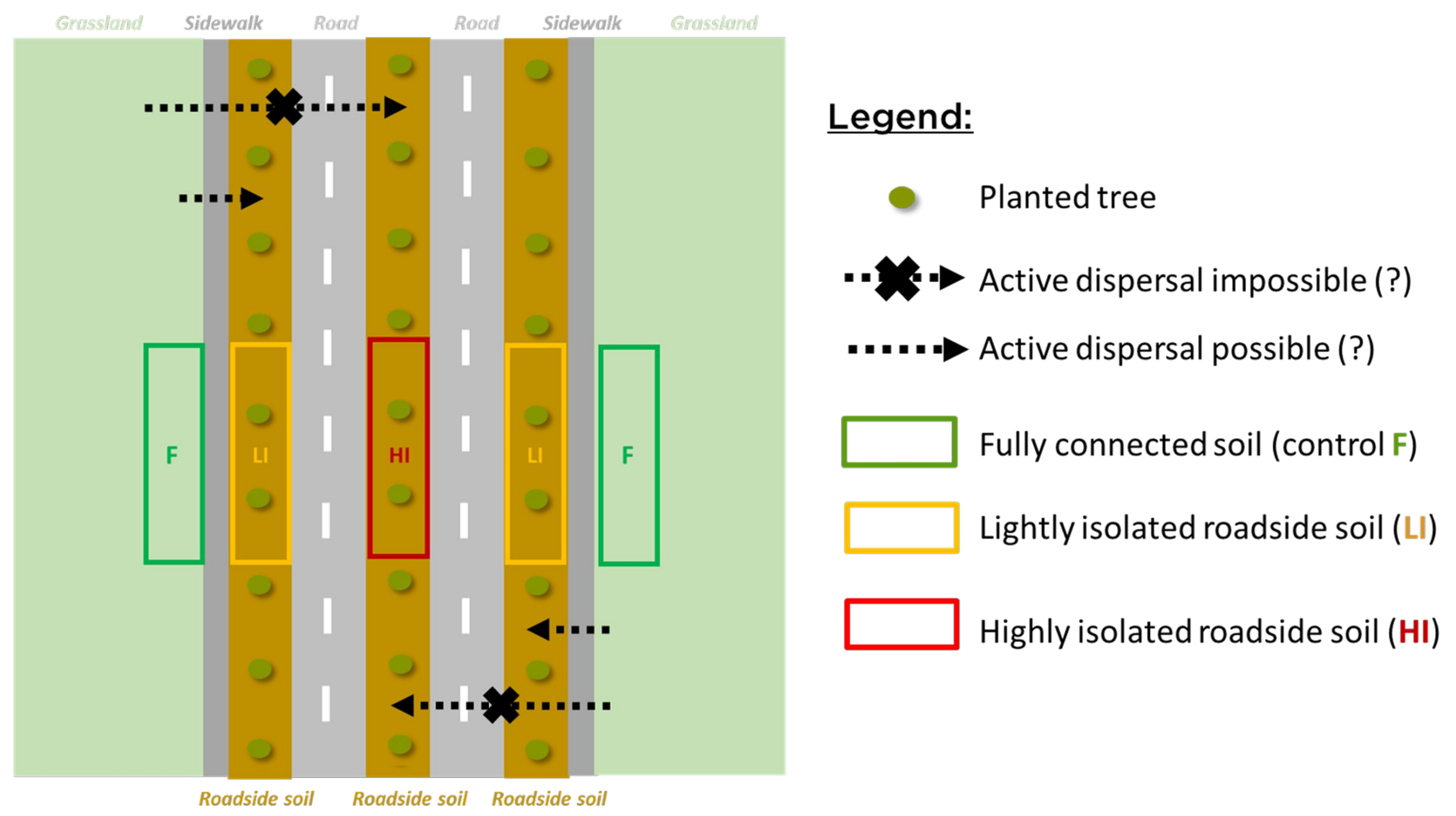
Materials & methods

Study sites

- Study conducted in an urban landscape in the suburbs of Paris
- The cities studied (Palaiseau and Saint-Quentin-en-Yvelines) expands on a substrate characterized by fine loess deposits and most of soils are **Luvisols (L)**
- Soils selected are linear reconstructed Anthroposoils of two different age (4- and 20-year-old) made by following the same advanced engineering processes

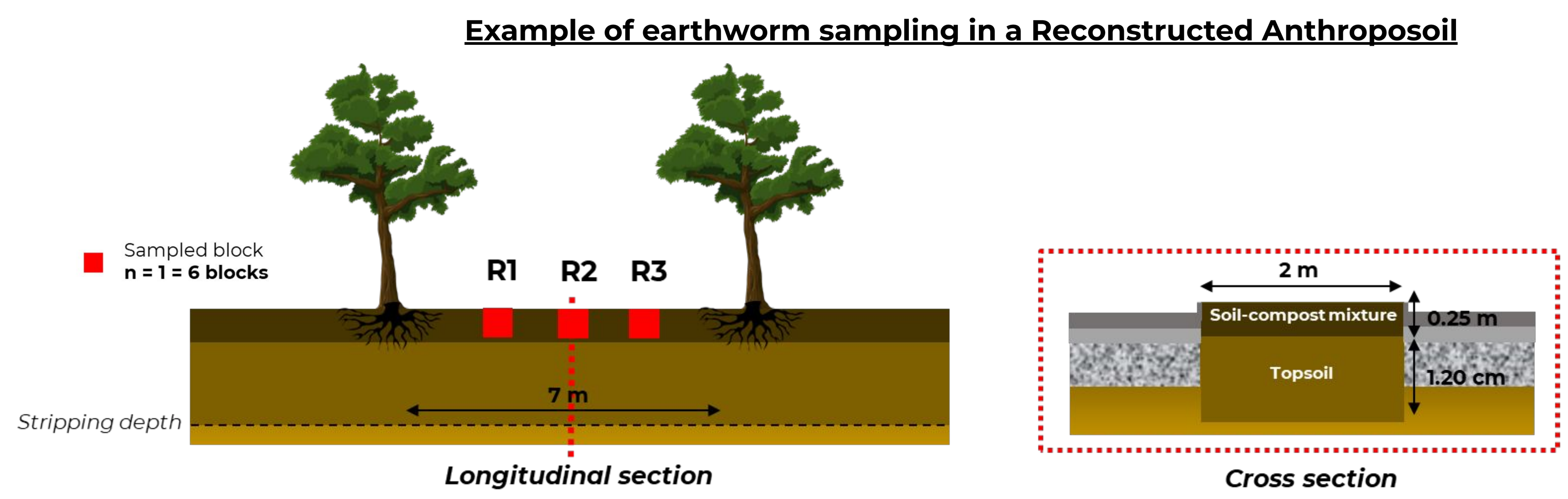


- Within each reconstructed Anthroposoil (4RA and 20RA), 2 levels of soil isolation were defined depending on the **type of road infrastructure** (a 3 m-sidewalk or a 6 m-road) separating reconstructed soils from pseudo-natural Luvisols



Earthworm sampling

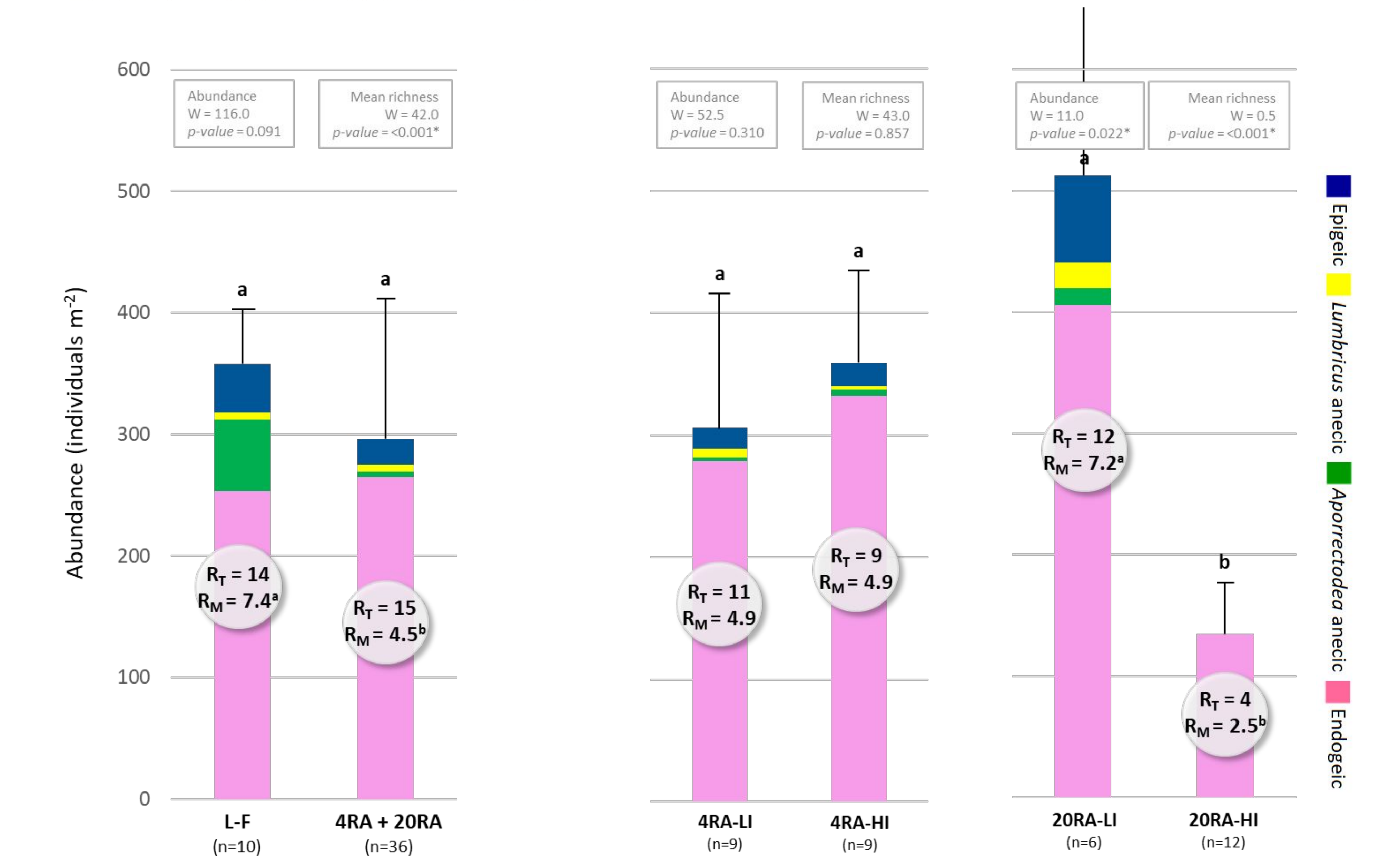
- Each earthworm sampling consisted of extracting **6 blocks** of soil (20 cm × 20 cm × 25 cm, length × width × depth) in 2 consecutive inter-trees and hand-sorting to collect earthworms
- 5 groups were studied: (i) **L-F** (n=10), (ii) **4RA-LI** (n=9), (iii) **4RA-HI** (n=9), (iv) **20RA-LI** (n=6), and (v) **20RA-HI** (n=12)



Results

(1) Impacts of advanced soil engineering
Earthworm abundance and richness

(2) Impacts of road infrastructures
Earthworm abundance and richness



Highlights

- The **advanced soil engineering process** leading to reconstructed Anthroposoils **negatively impacted overall earthworm community structure**, favoring a significant preponderance of endogeic species representing 90% of total abundance across all soils.
- In the case of **20-year-old reconstructed Anthroposoils** (20RA), earthworm parameters (abundance, biomass, total richness) were significantly **lower in fully isolated soils** (i.e., surrounded by roads) **than in partially isolated soils** (i.e., bordered by a road only on one side), including the absence of three ecological categories (epigeic, *Lumbricus* anecic, and *Aporrectodea* anecic earthworms).
- No differences were observed in 4-year-old reconstructed Anthroposoils (4RA) regardless of soil isolation by road infrastructures.

References

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