

ECOPOLIS project: The transformation of a contaminated industrial wasteland into a living-lab based on a phytomanagement approach



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Jordan Collot

General objective

Rehabilitation of the industrial wasteland of Vieux-Charmont by phytomanagement

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General objective

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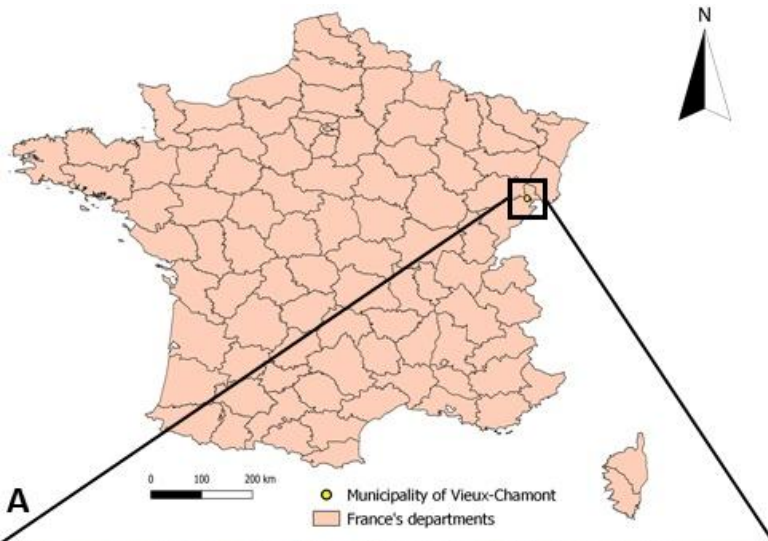
Specific objectives

Characterize spatially and quantitatively the contents of trace elements (TE) and its health and environmental impacts

To set-up a living-lab to test different pollution management scenarios based on phytomanagement

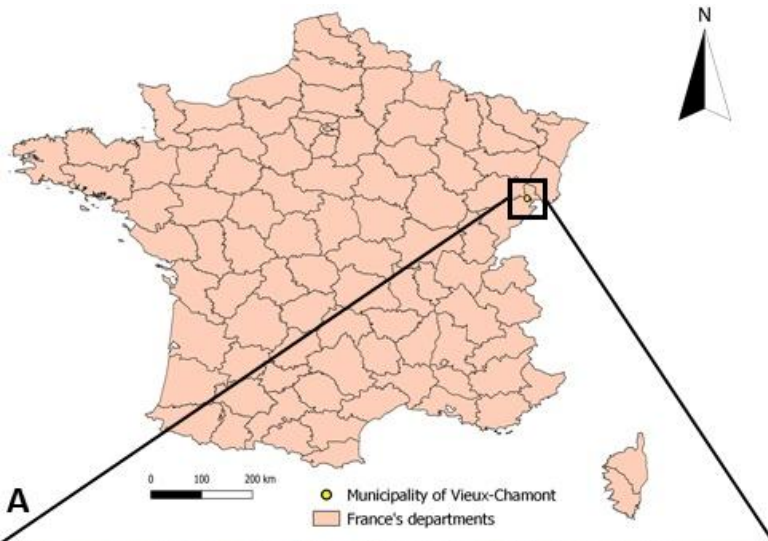
Assess the potential for reproducibility on other industrial wasteland in the territory

The industrial wasteland of Vieux-Charmont



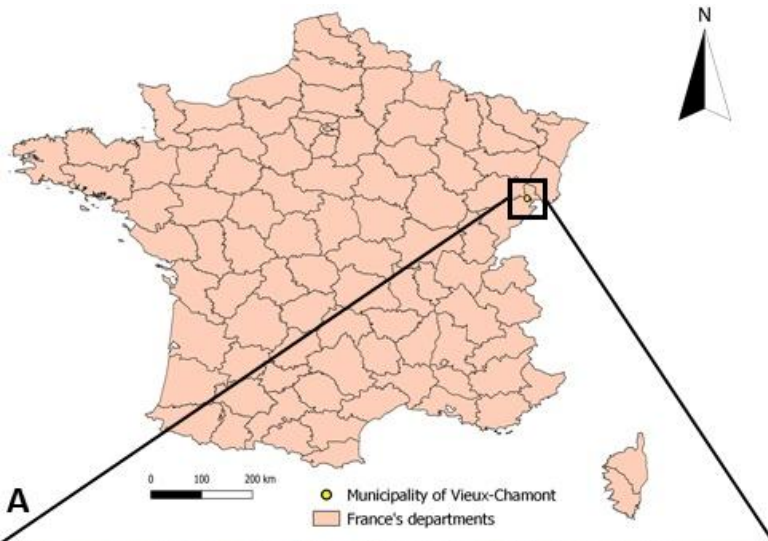
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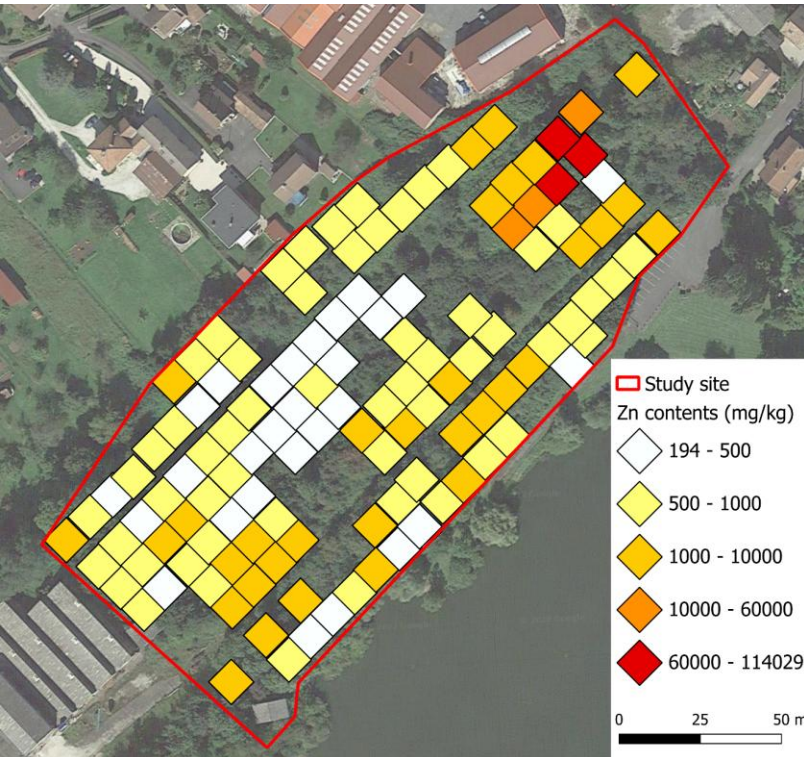


- Study site: Close to a factory in operation since 1871.
- Several activities such as watchmaking and fabrication of car pieces took place in the factory.
- Industrial and domestic wastes found on soil.

TE contents in soil

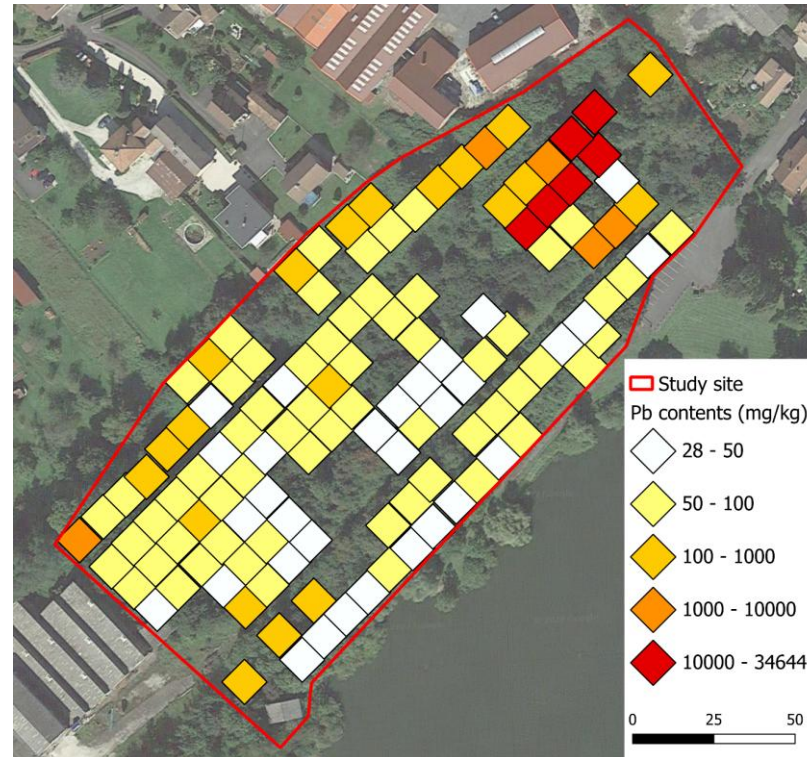
Zinc

194 – 114 000 mg/kg



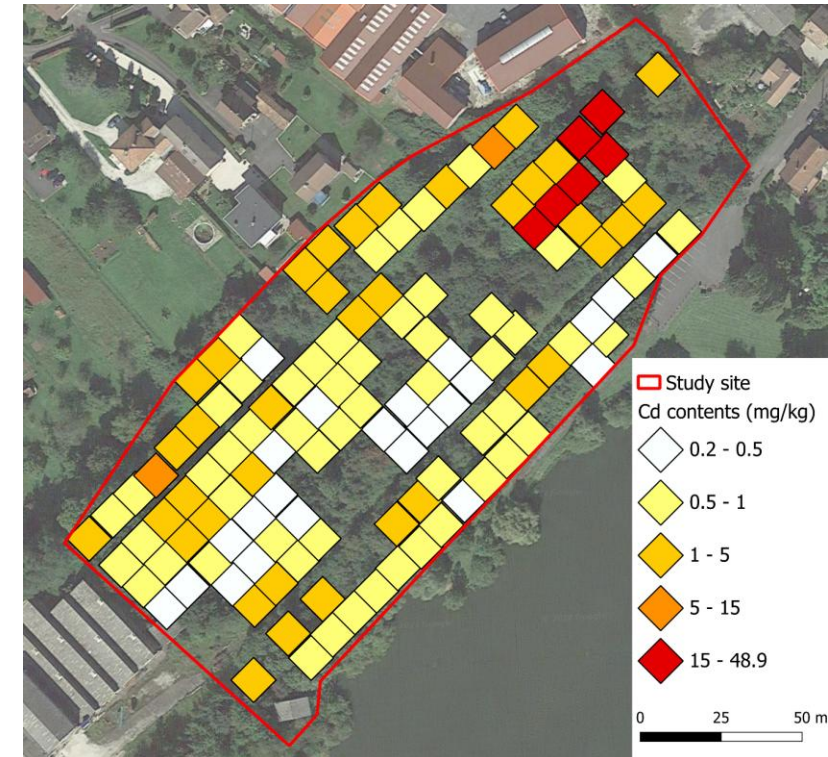
Lead

28 – 34 600 mg/kg



Cadmium

0.2 – 48.9 mg/kg



Other contaminants:

Sn: 2 – 13 600 mg/kg

Hg: 0.12 – 4.5 mg/kg

Ni: 16 – 1 645 mg/kg

As: 11 – 105 mg/kg

TE	World-soil average contents (mg/kg)	TE	World-soil average contents (mg/kg)
Zn	70	Hg	0.07
Pb	27	Ni	29
Cd	0.41	As	6.83
Sn	2.5		

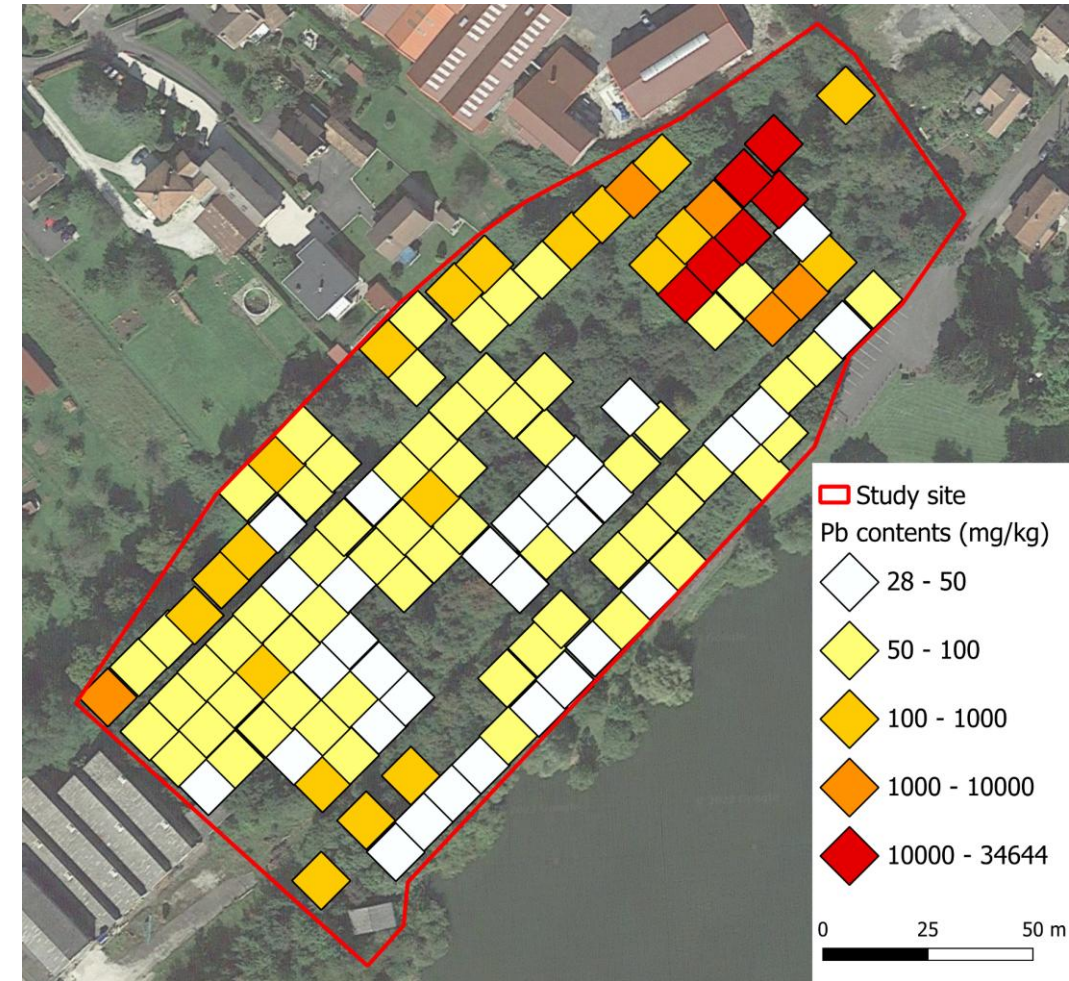
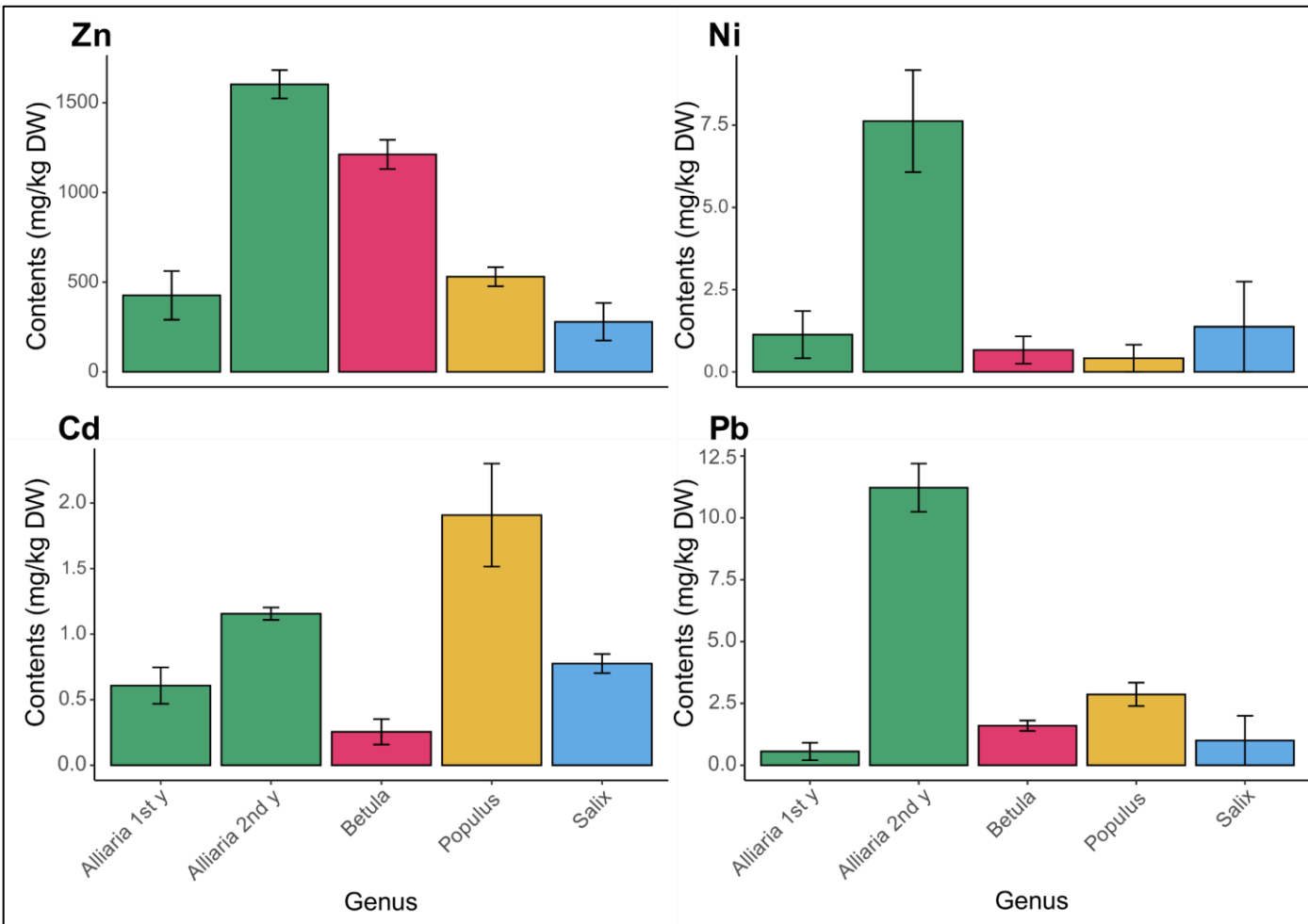
World-soil average contents values from [Kabata-Pendias \(2010\)](#)

TE transferts from soil



TE transfers from soil to vegetation

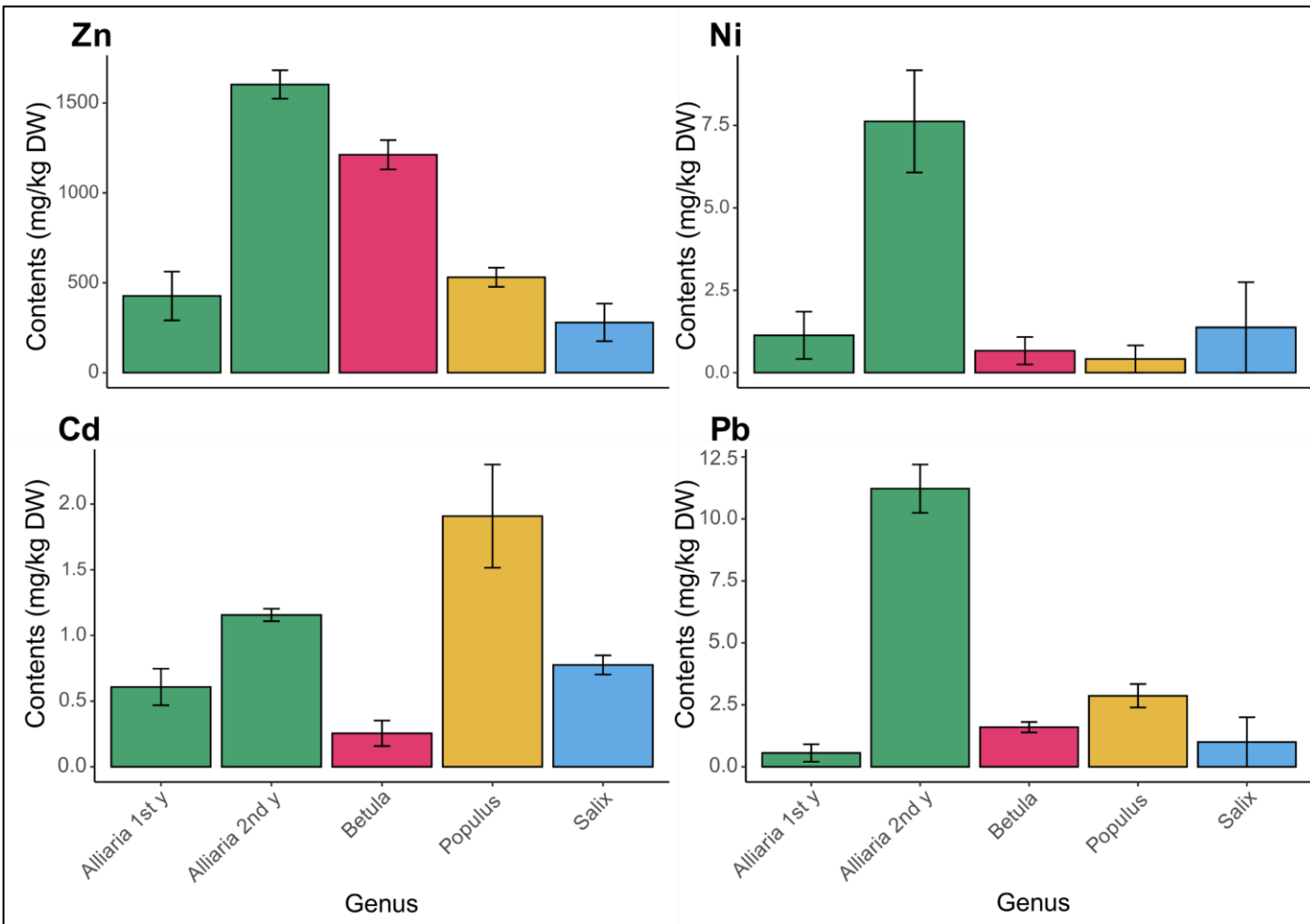
TE contents in leaves of accumulative species on highly contaminated localization.



TE transfers from soil to vegetation

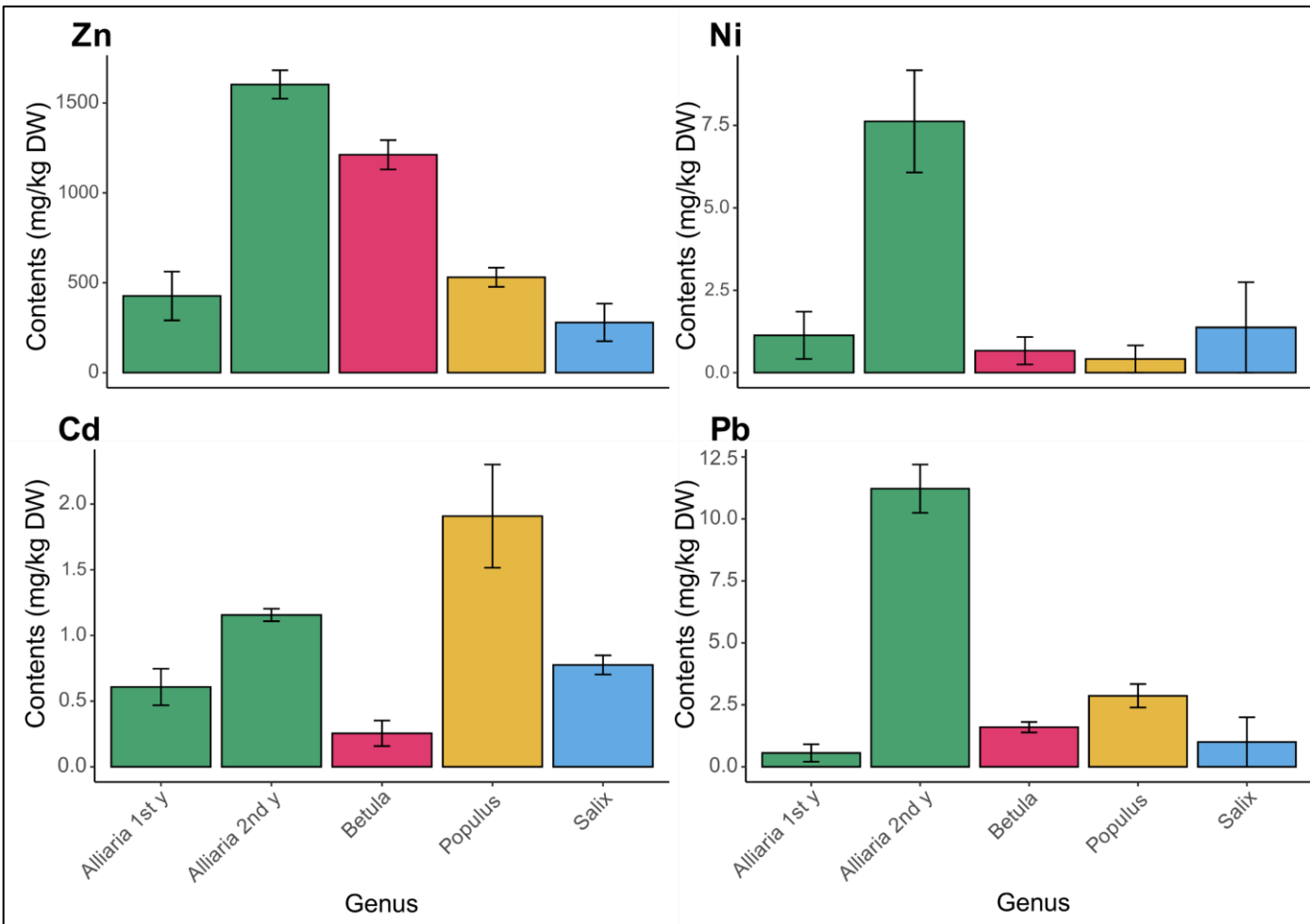
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TE contents in leaves of accumulative species on highly contaminated localization.



- *Betula*, *Populus* and *Salix* are well known genera that are accumulating Zn and/or Cd (Ciadamidaro et al., 2019).
- *Alliaria petiolata* is an edible biannual plant from the *Brassicaceae* family.

Cavers et al., 1979



1st year plant

2nd year plant

TE transfers from soil to vegetation



- *Alliaria petiolata* is accumulating large amounts of Zn in leaves.
- Its a fast growth rate and high biomass production plant (Grabner et al., 2010).
 - *Alliaria petiolata* is suitable for **phytoremediation**.

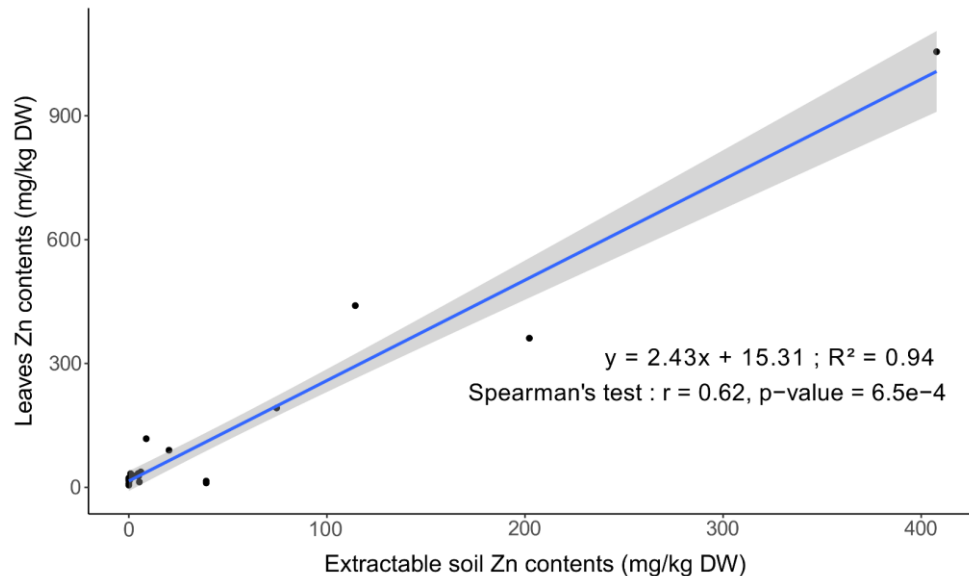
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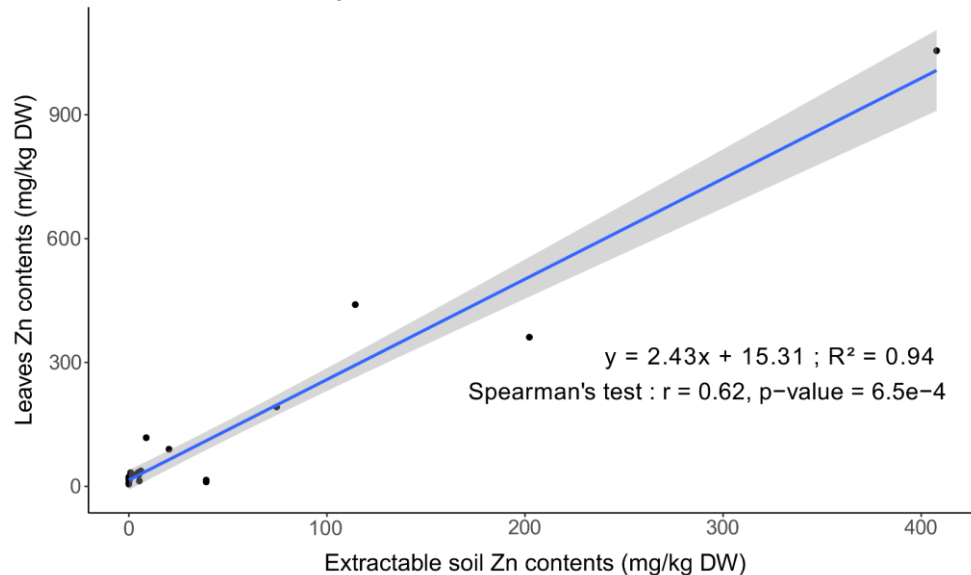
Relation between CaCl_2 extractable Zn contents and *Alliaria petiolata* leaf Zn contents.



TE transfers from soil to vegetation



Relation between CaCl_2 extractable Zn contents and *Alliaria petiolata* leaf Zn contents.



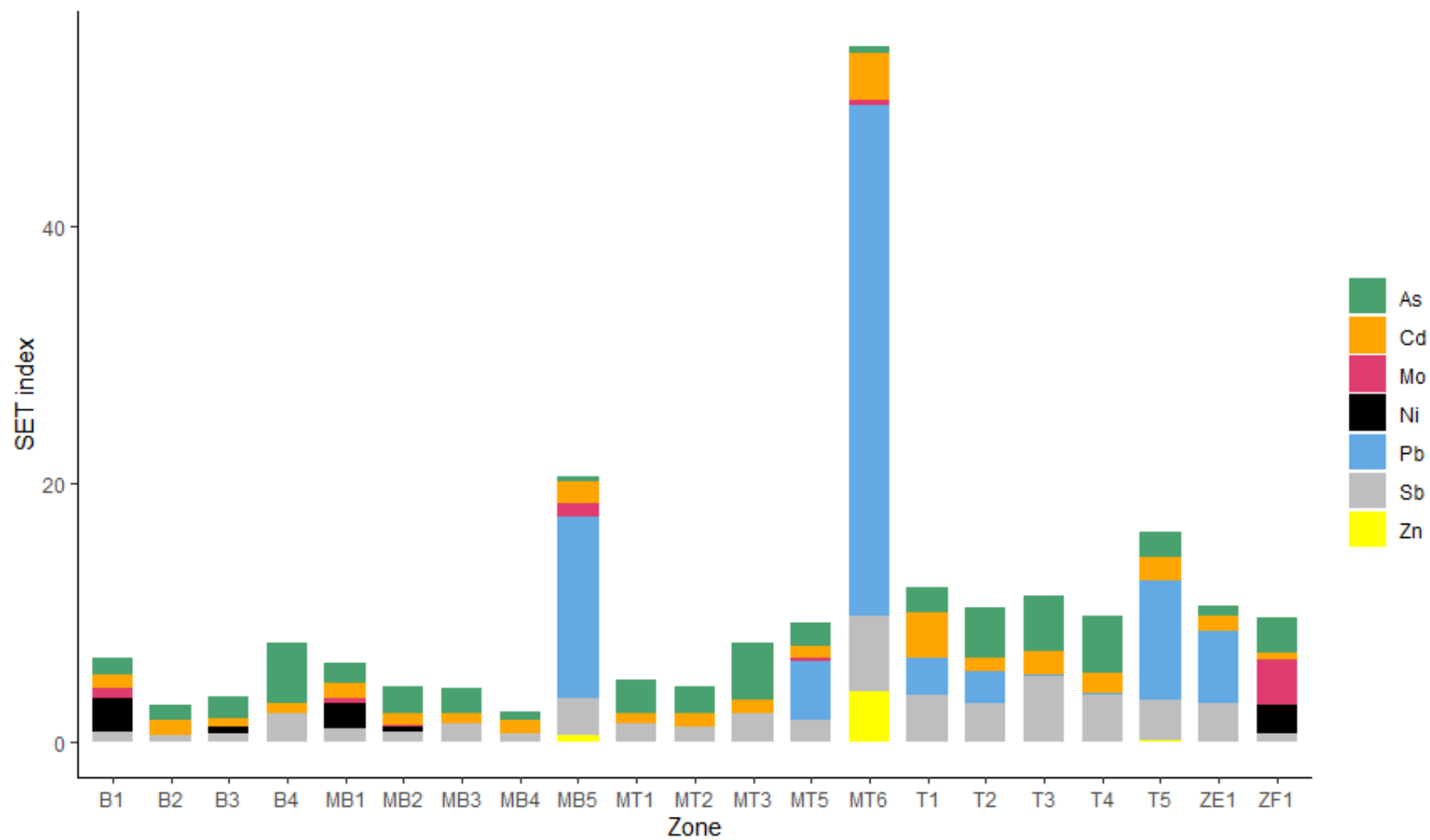
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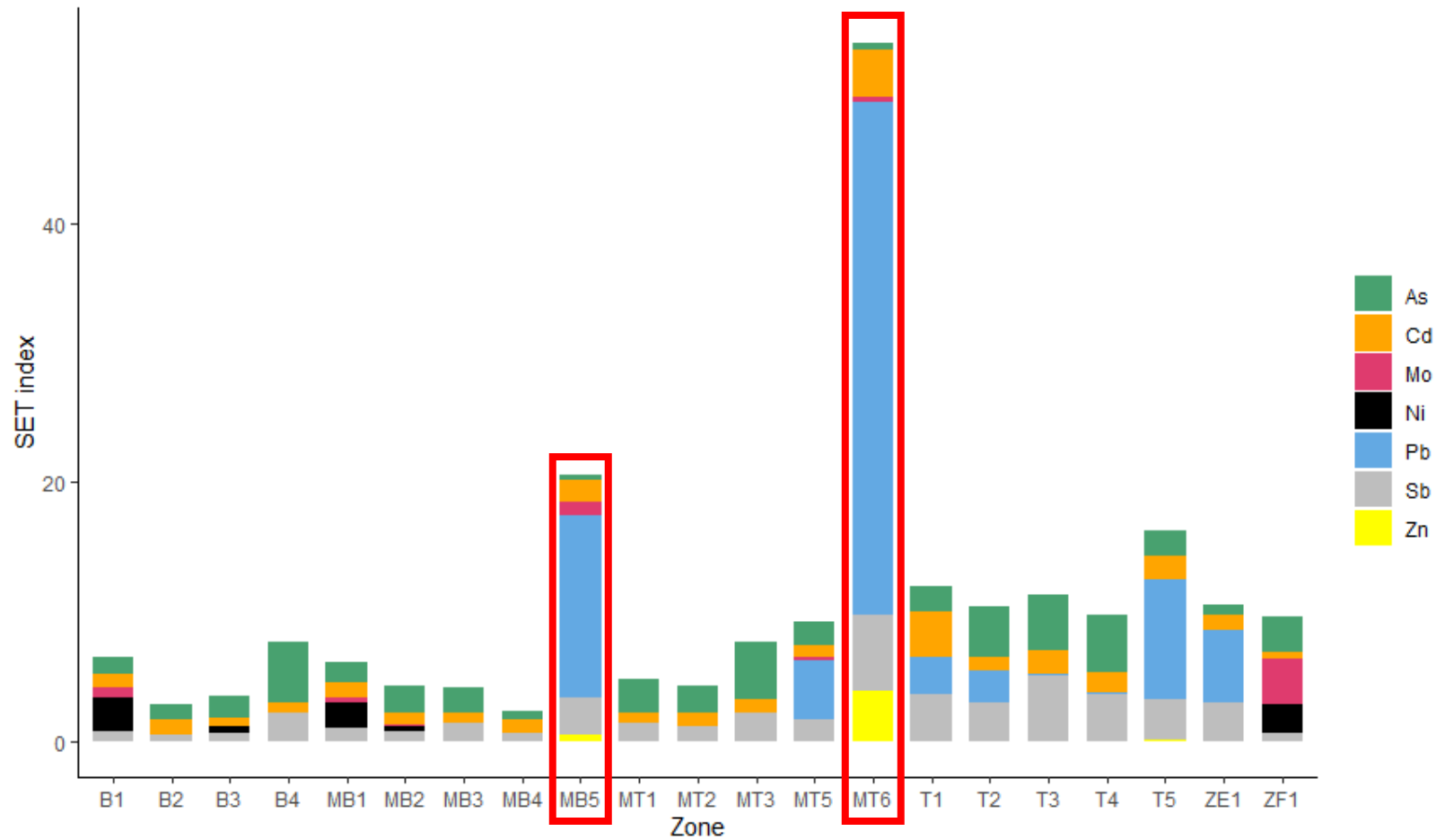
- The leaf contents are related to the CaCl_2 extractable soil contents.
- It is also one of the dominant plant of the site.

→ *Alliaria petiolata* is a relevant species for **Zn bioindication**.

TE transfers to snails



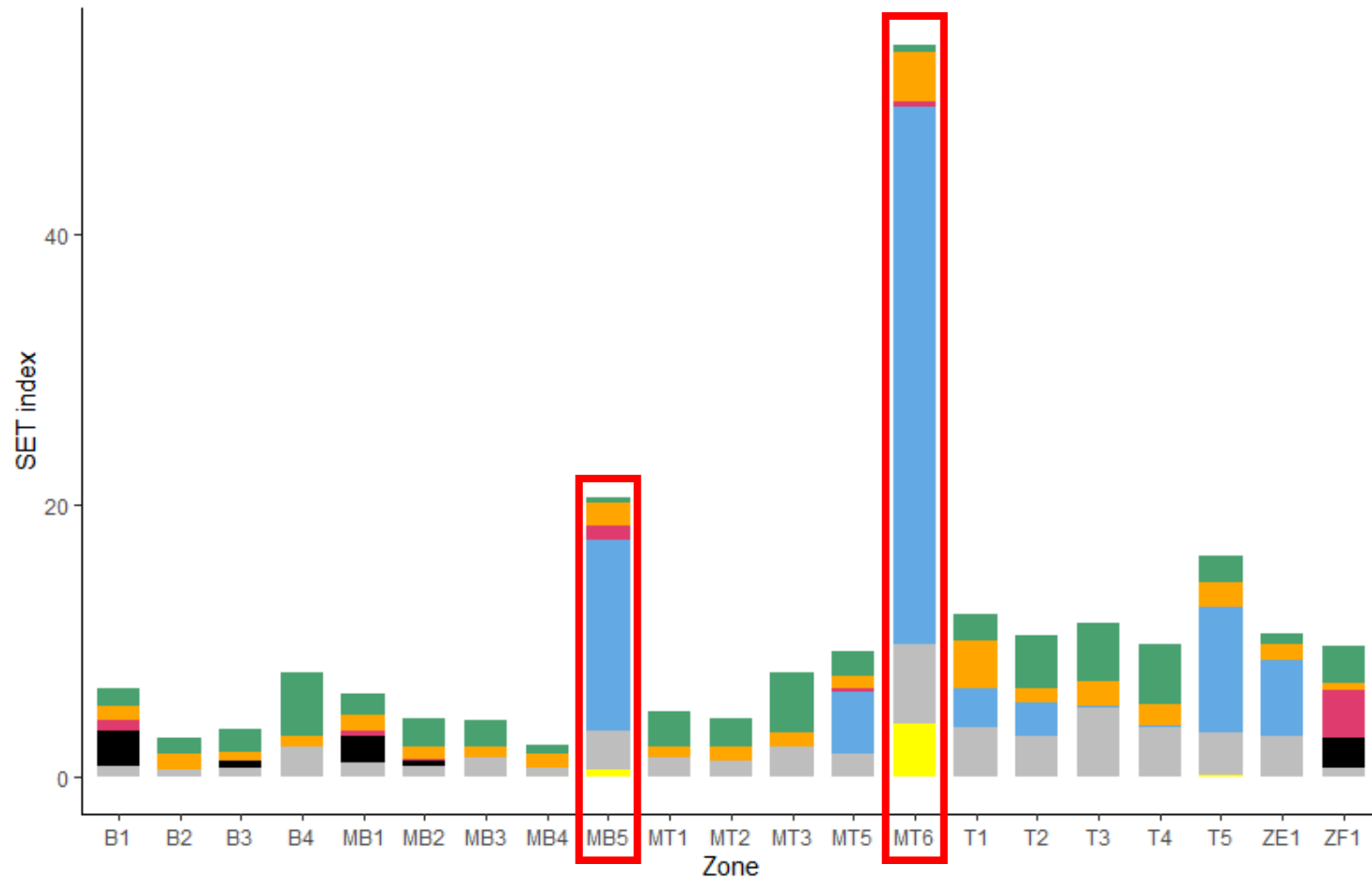
TE transfers to snails



- All zones have SET index > 1
→ Excessive transfert to environment.



TE transfers to snails



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→ Excessive transfert to environment.
- TE contributions : Pb > As > Sb > Cd > others.



TE transferts to humans

- Measurement of hazard indices : $HI = DI/TRV$.

DI : Daily intake of studied TE (mg/kg/d).

TRV : Toxicity reference value (mg/kg/d) (INERIS).

TE transferts to humans

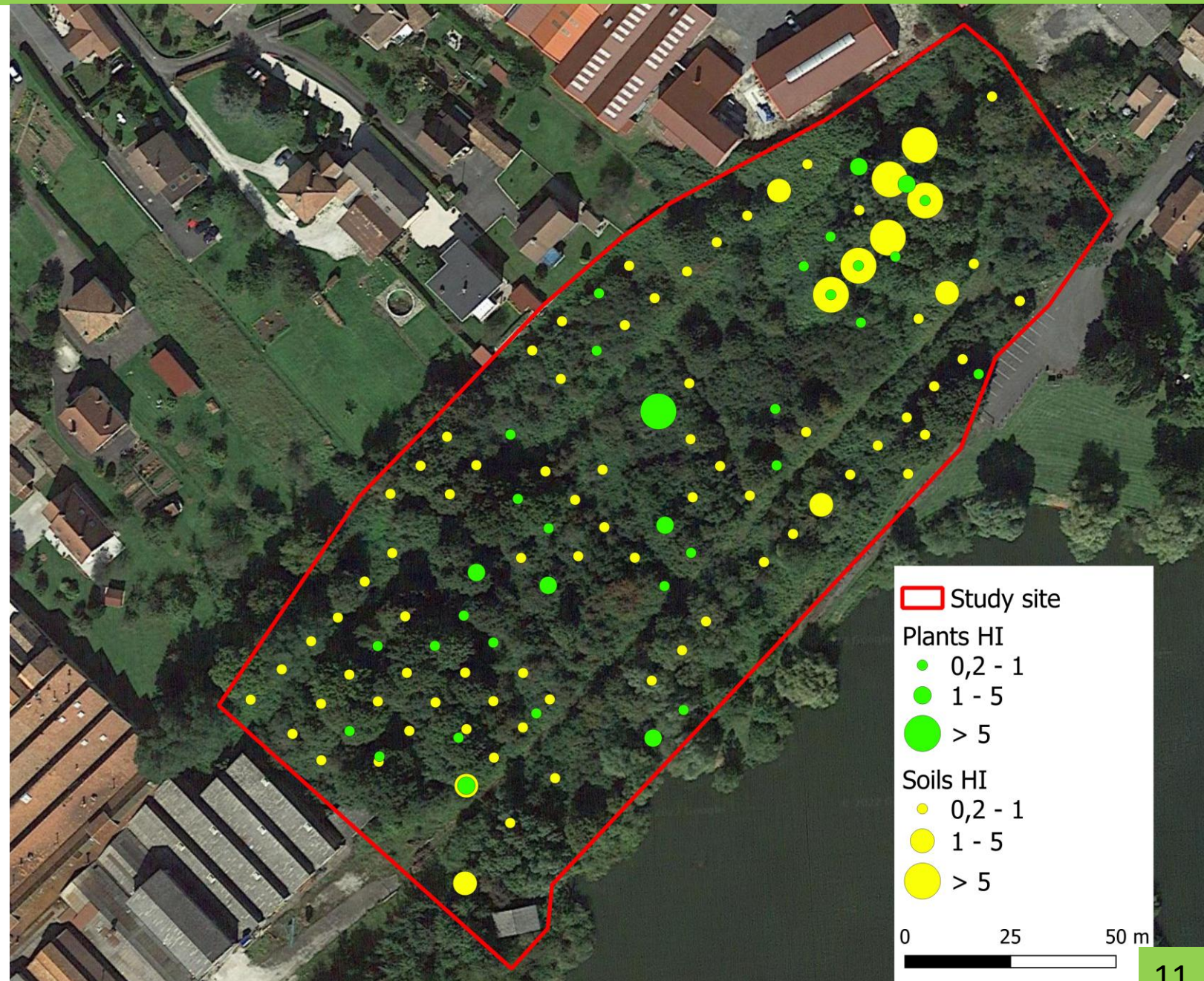
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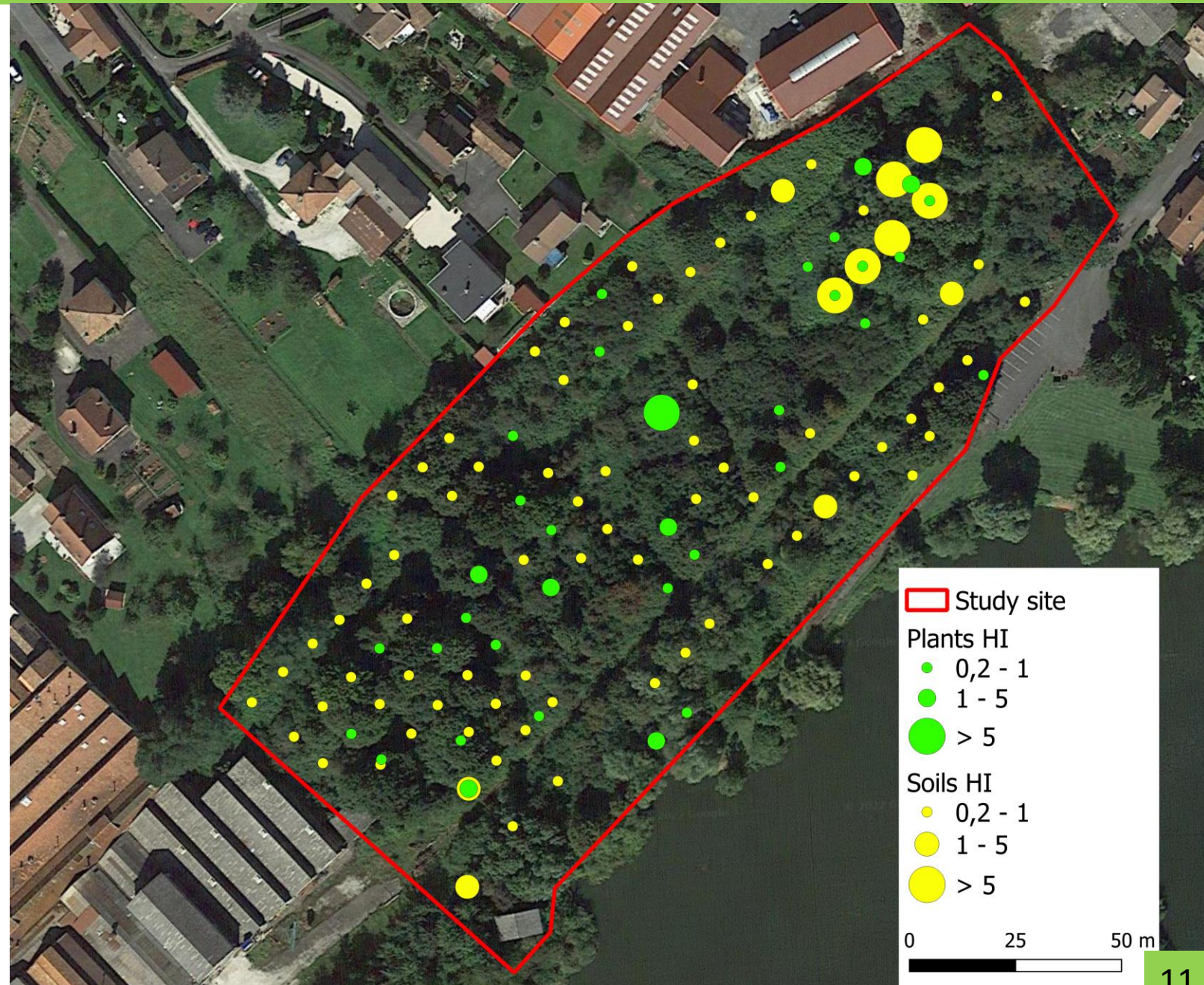
Parameters	Scenario 1 ingestion of soil	Scenario 2 Ingestion of edible plant
Number of day of exposition per year	104 d	26 d
Daily ingestion of contaminated material	91 mg/d	100 g/d
Duration of exposure	6 y	15 y
Weight of the person	15 kg	70 kg

TE transfers to humans



TE transfers to humans

- Scenario 1 : Soil HI > 1 are mainly due to Pb contents in soil.
→ Explained by total soil contents.



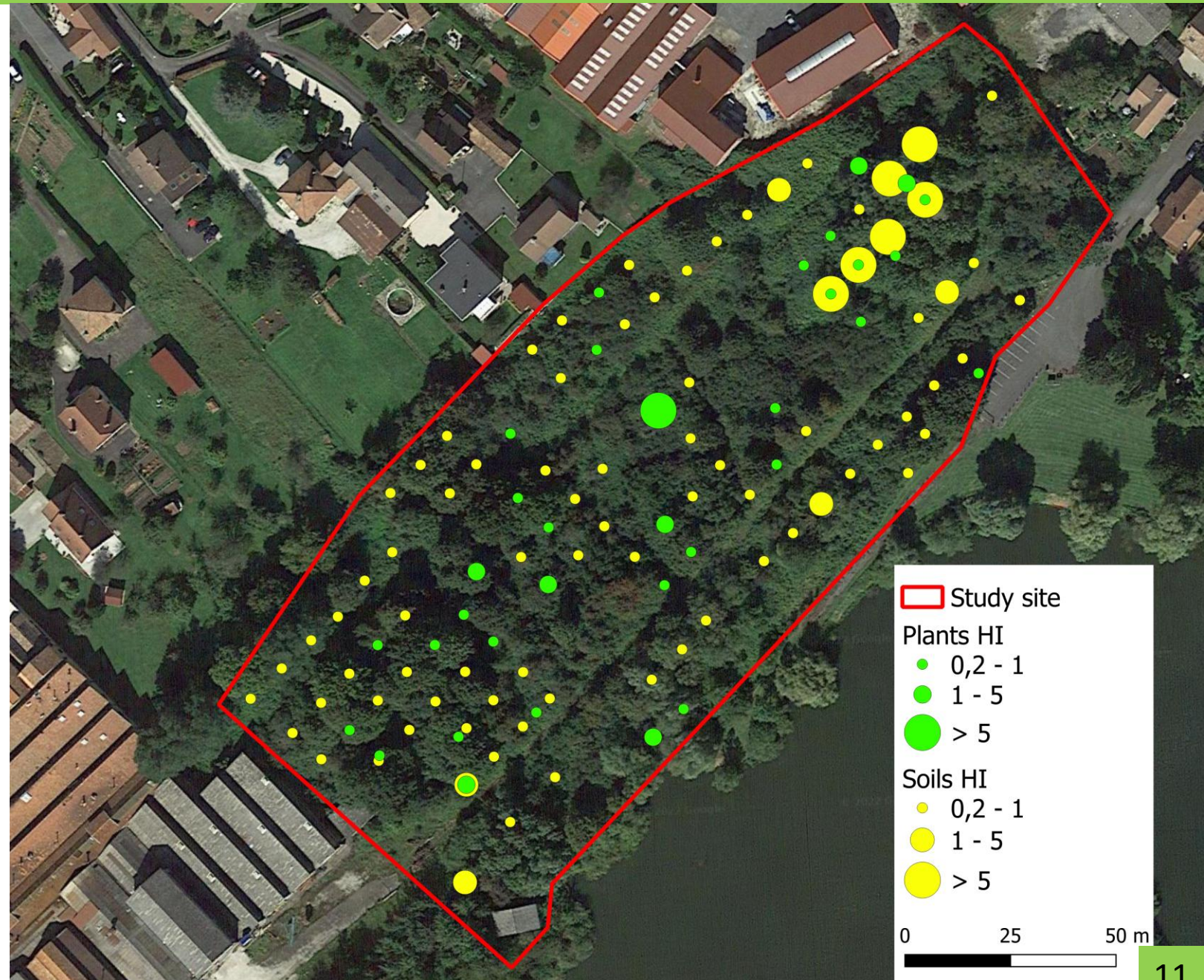
TE transfers to humans

- Scenario 1 : Soil HI > 1 are mainly due to Pb contents in soil.

→ Explained by total soil contents.

- Scenario 2 : Plant HI > 1 are mainly due to Cd and As contents in leaves.

→ Explained by bioavailable soil contents and soil parameters (pH).



Conclusions

Key points

The analyses and index measurements carried out highlight environmental and human risks on the site.

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The TE contents in plants reveals interesting species for phytoremediation methods, especially *Alliaria petiolata*.



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The TE contents in plants reveals interesting species for phytoremediation methods, especially *Alliaria petiolata*.

The setting up of a living-lab on the site will allow the communication of the research conducted on the site to the public.





Bibliography

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Collègues :

C Bertheau, G Bertrand, P Binet, M Chalot, L Ciadamidaro, J Parelle, F Tatin-Froux, ML Toussaint (Chrono)
B Pauget (TESORA)
N Kieffer (PMA)
S Domas, C Guyeux (FEMTO)
C Kuhn (ADU-PMA)

TE transferts to snails

- Bioindicator snails (*Cantareus aspersus*) have been set up in zones with equivalent TE contents.
- After 28 days on site, TE contents in snails are analysed by ICP for measurement of the sum of excessive transferts (SET index).



Microcosms with several snails are set up in each determined zones during 28 days.

Snails are analysed with ICP MS after acid digestion

