Using portable XRF devices for quick and low-cost measurement of metal content in soils, plants and mushrooms in peri-industrial areas of Wallonia

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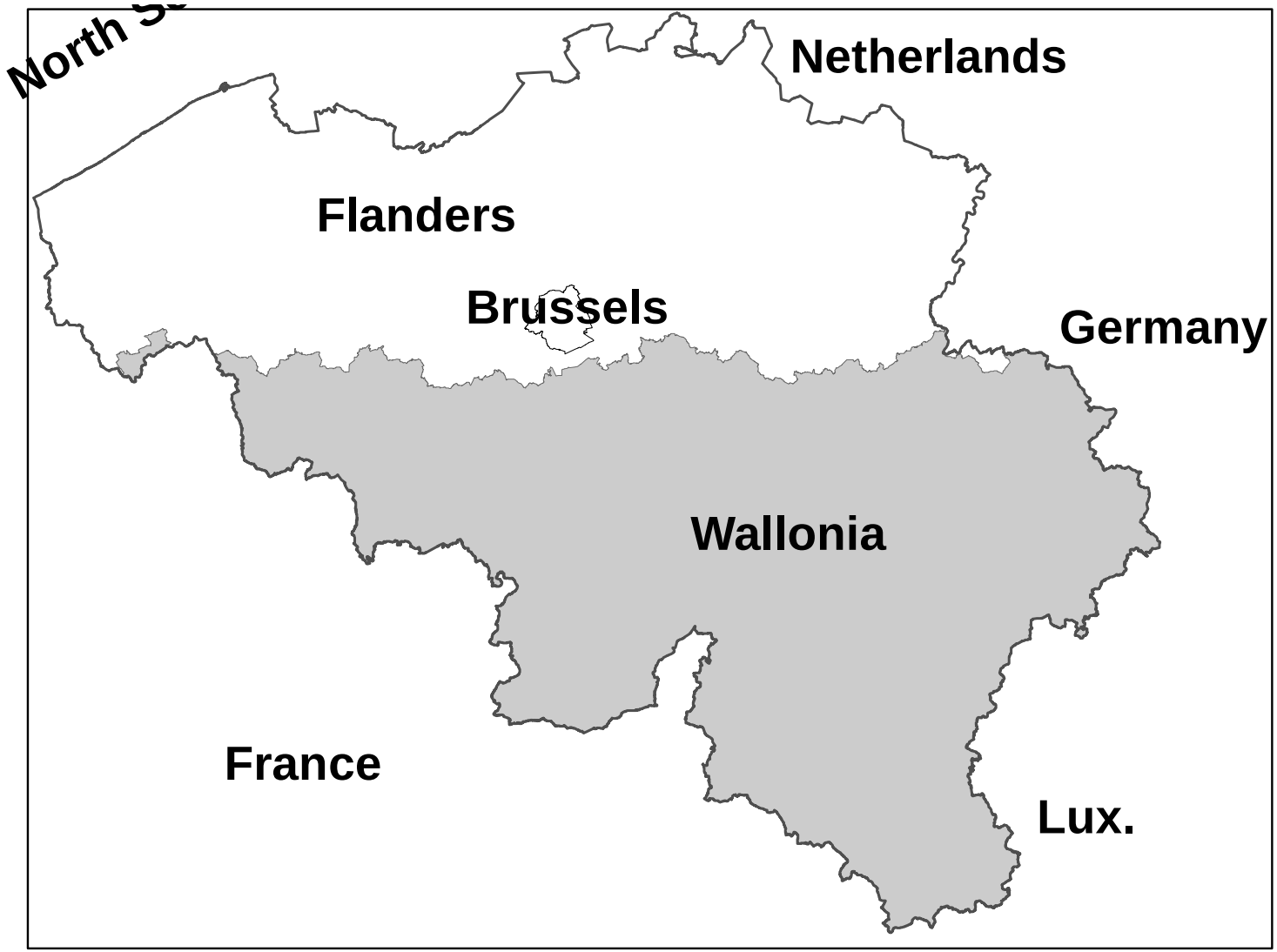
Wallonie
SPW Service public de Wallonie
DGO 3

Wallonia


Netherlands
Flanders
Brussels
Germany
Wallonia
France
Lux.

Wallonia : long history of industrial activity

Zn smelting plant,
Angleur, Liège, 1855

Steelmaking blast furnaces
Seraing, Liège, 2012

Can the pXRF provide reliable measurements of metals in the environment

(soils - herbaceous plants - mushrooms) ?

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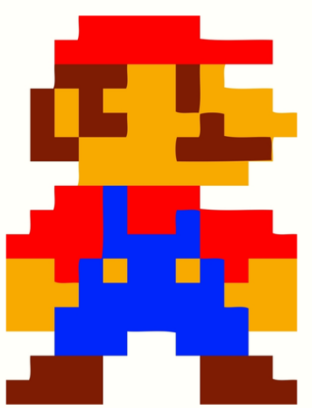
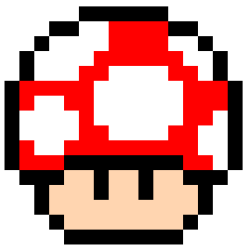
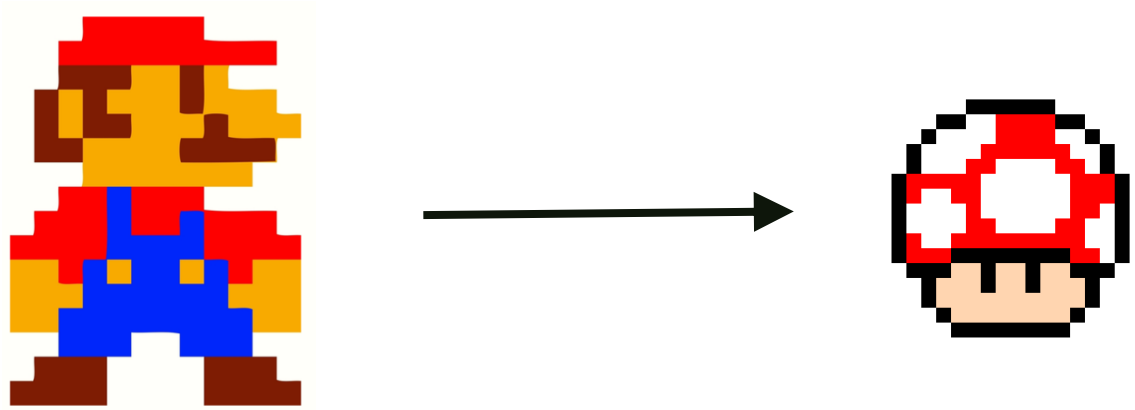
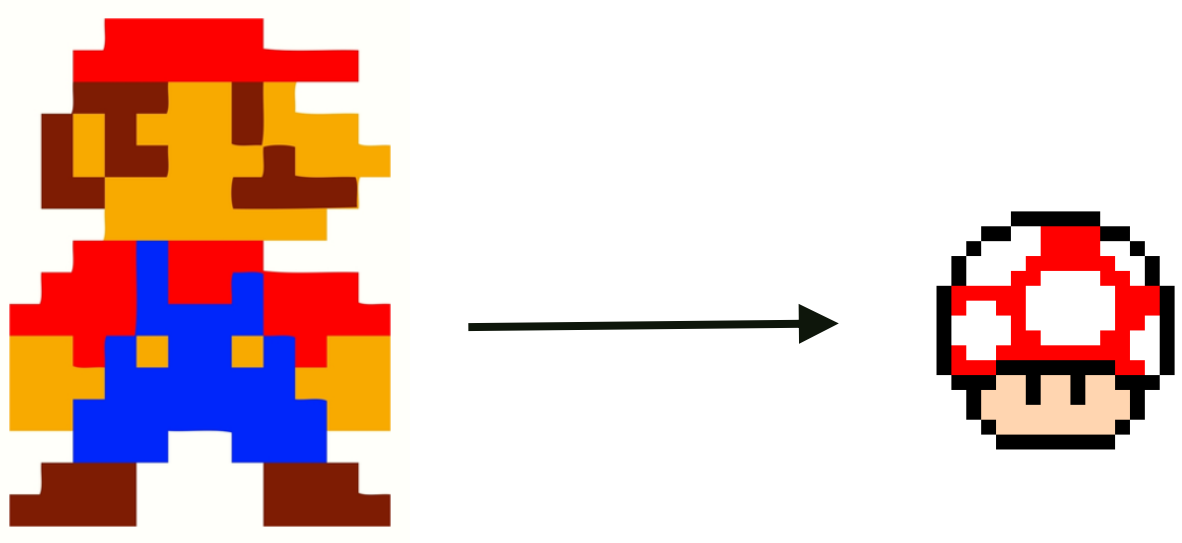
(soils - herbaceous plants - mushrooms) ?

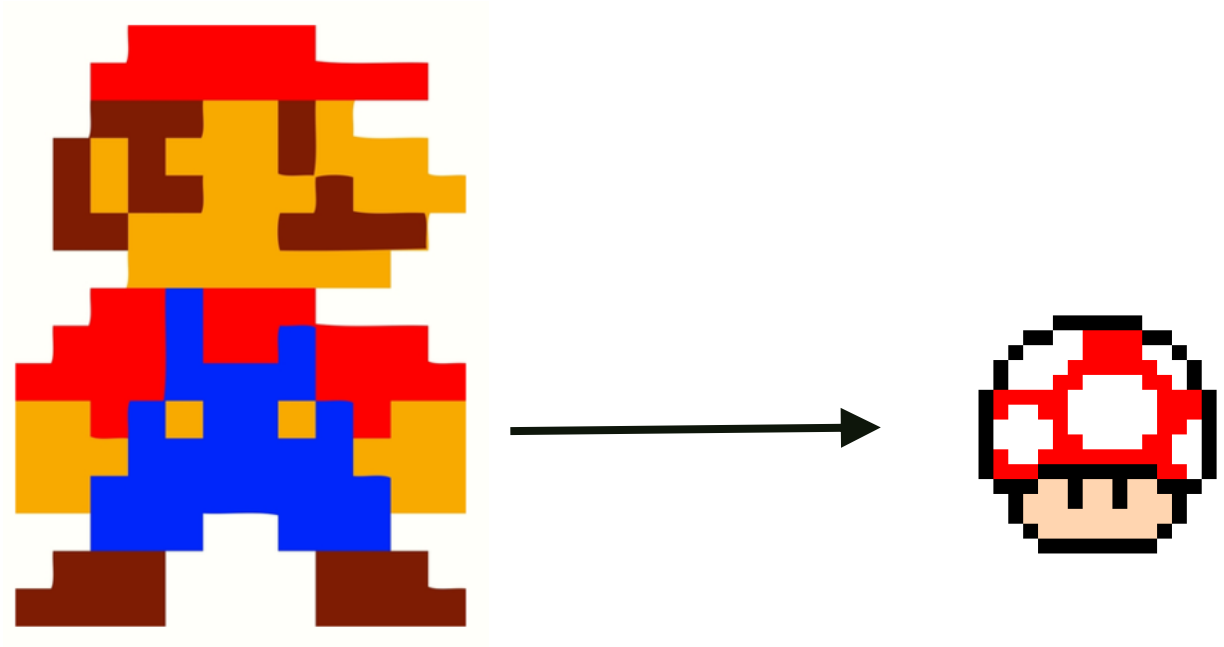
➔ Comparison with reference methods

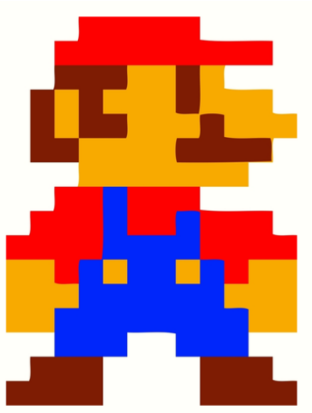


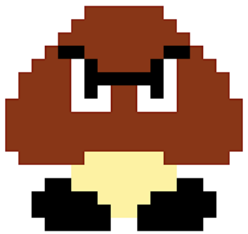


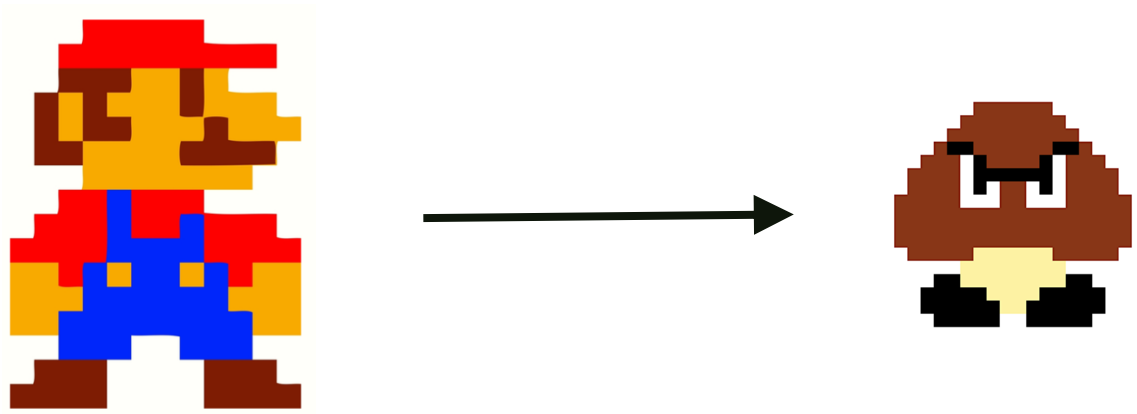


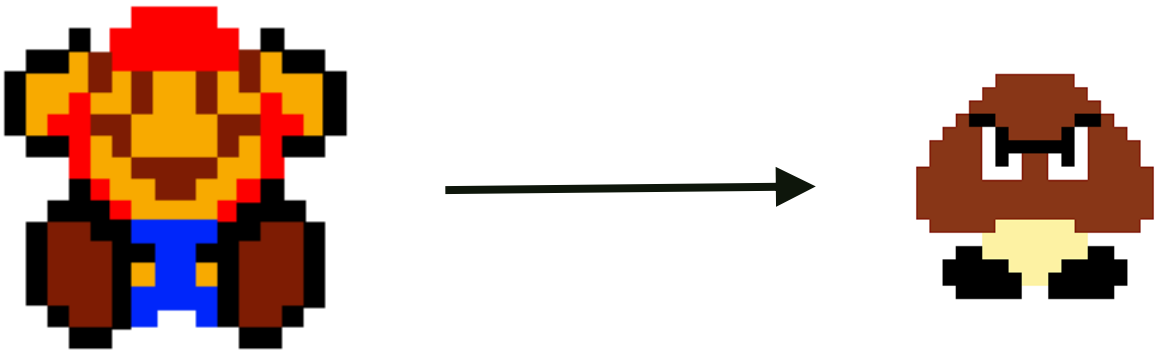


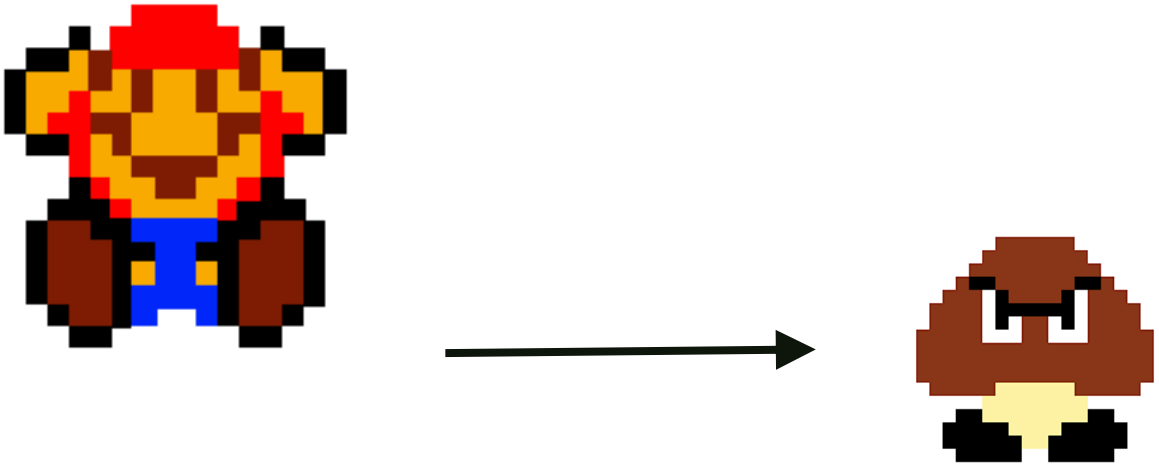


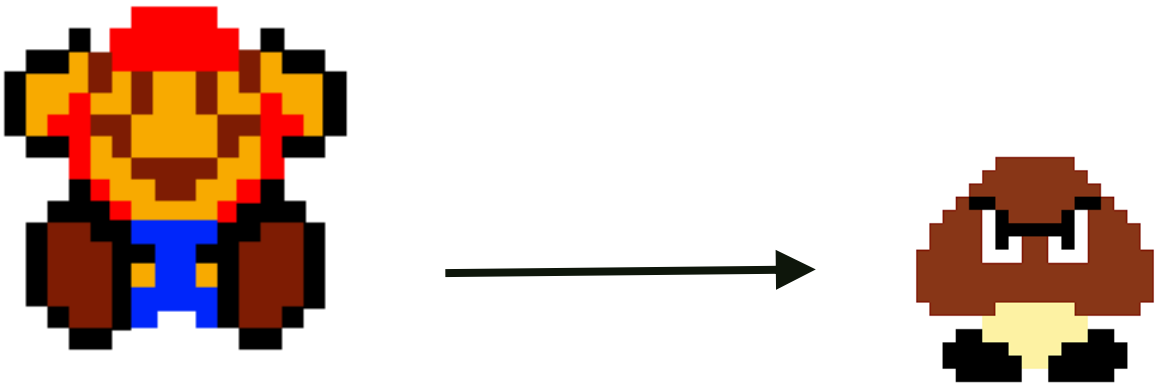


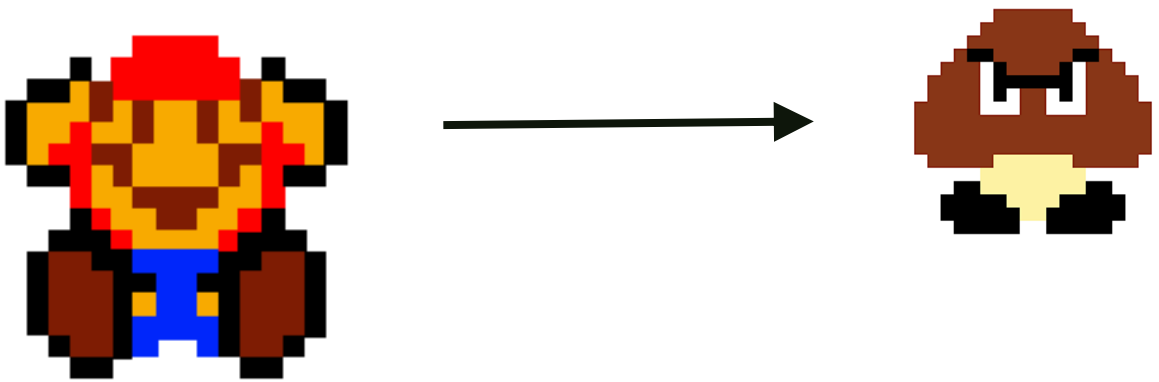


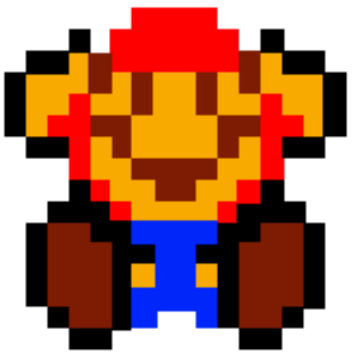


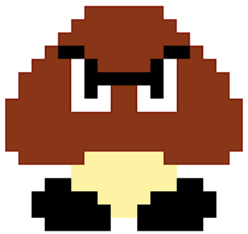


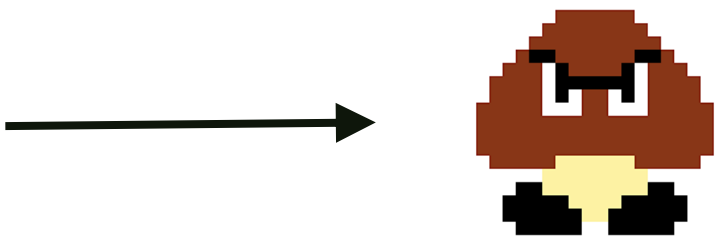




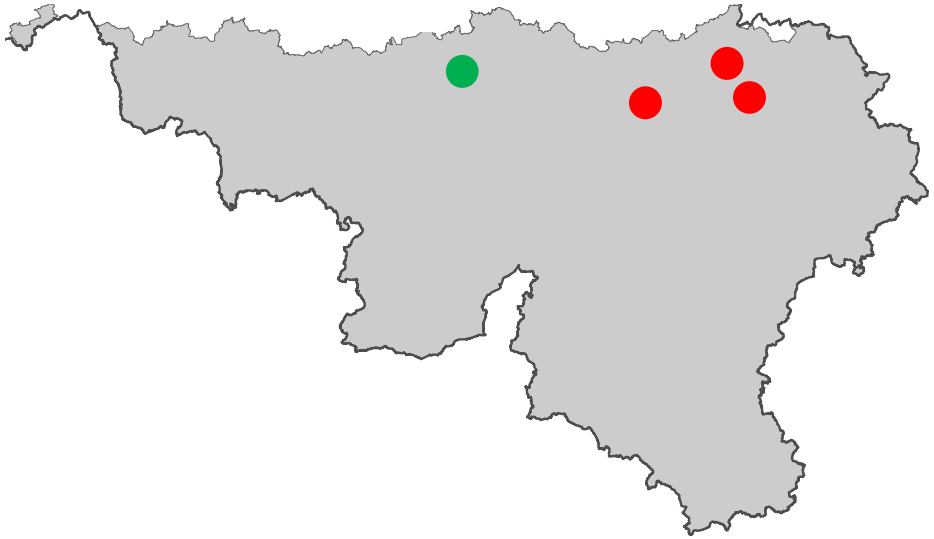






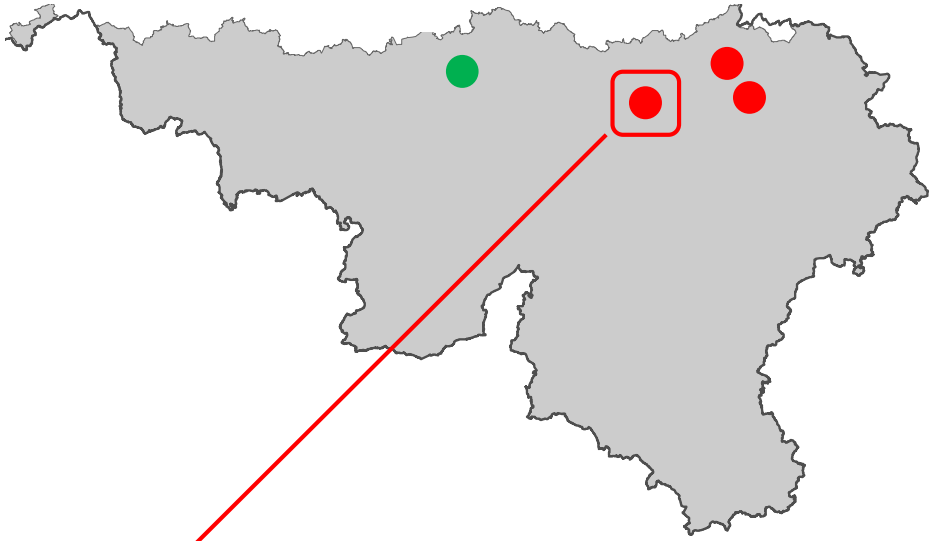


Sampling strategy



- Control site
- Contaminated sites

Sampling strategy



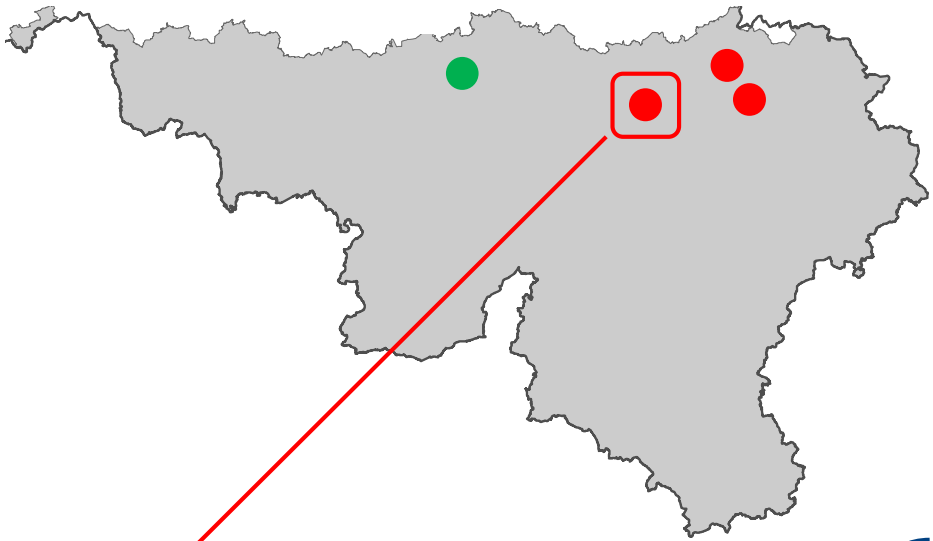
Control site

Contaminated sites

1 site :

5 sampling locations

Sampling strategy



Control site

Contaminated sites

1 site :

5 sampling locations

1 sampling location :

soil

litter

mushroom

herbaceous plant

Mushrooms

Lepista nuda

Macrolepiota procera

Stropharia aeruginosa

Coprinus comatus

Hydnum repandum

Herbaceous plants

Brachypodium syvaticum

Dactylis glomerata

Carex Muricata

Reference protocols

pXRF protocols

Reference protocols

pXRF protocols

Aqua regia digestion + ICP

Aqua regia digestion + ICP

HNO_3 digestion + ICP

HNO_3 digestion + ICP

	Reference protocols	pXRF protocols
		
	Aqua regia digestion + ICP	Fresh *in situ*
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	HNO_3 digestion + ICP	Fresh *in situ*
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Reference protocols

pXRF protocols

Aqua regia digestion + ICP

Fresh *in situ*

Dried – sieved 2mm

Aqua regia digestion + ICP

Fresh *in situ*

Dried – crushed

HNO_3 digestion + ICP

Fresh *in situ*

Dried – crushed

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Fresh *in situ*

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Fresh *in situ*

Dried – crushed

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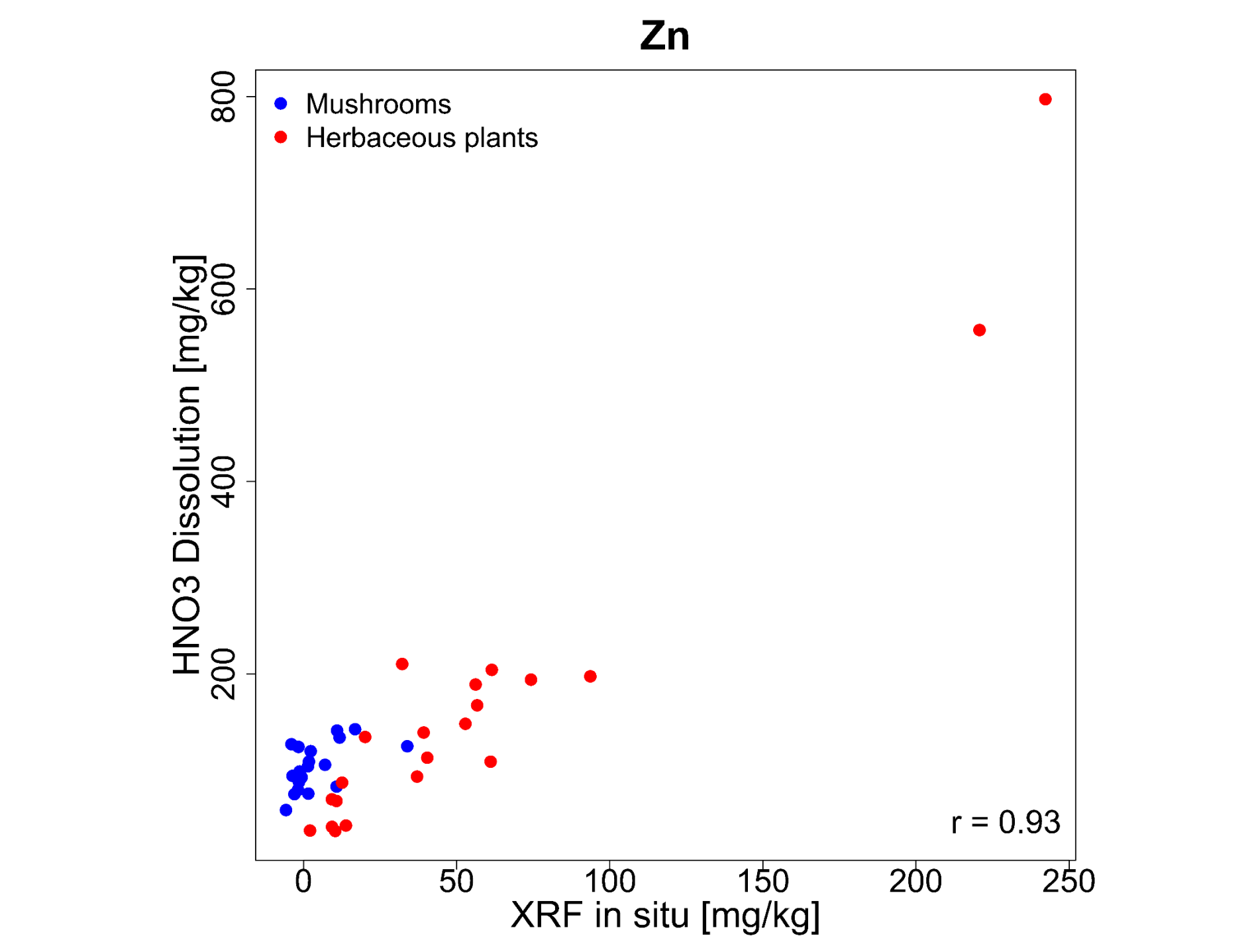
Fresh *in situ*

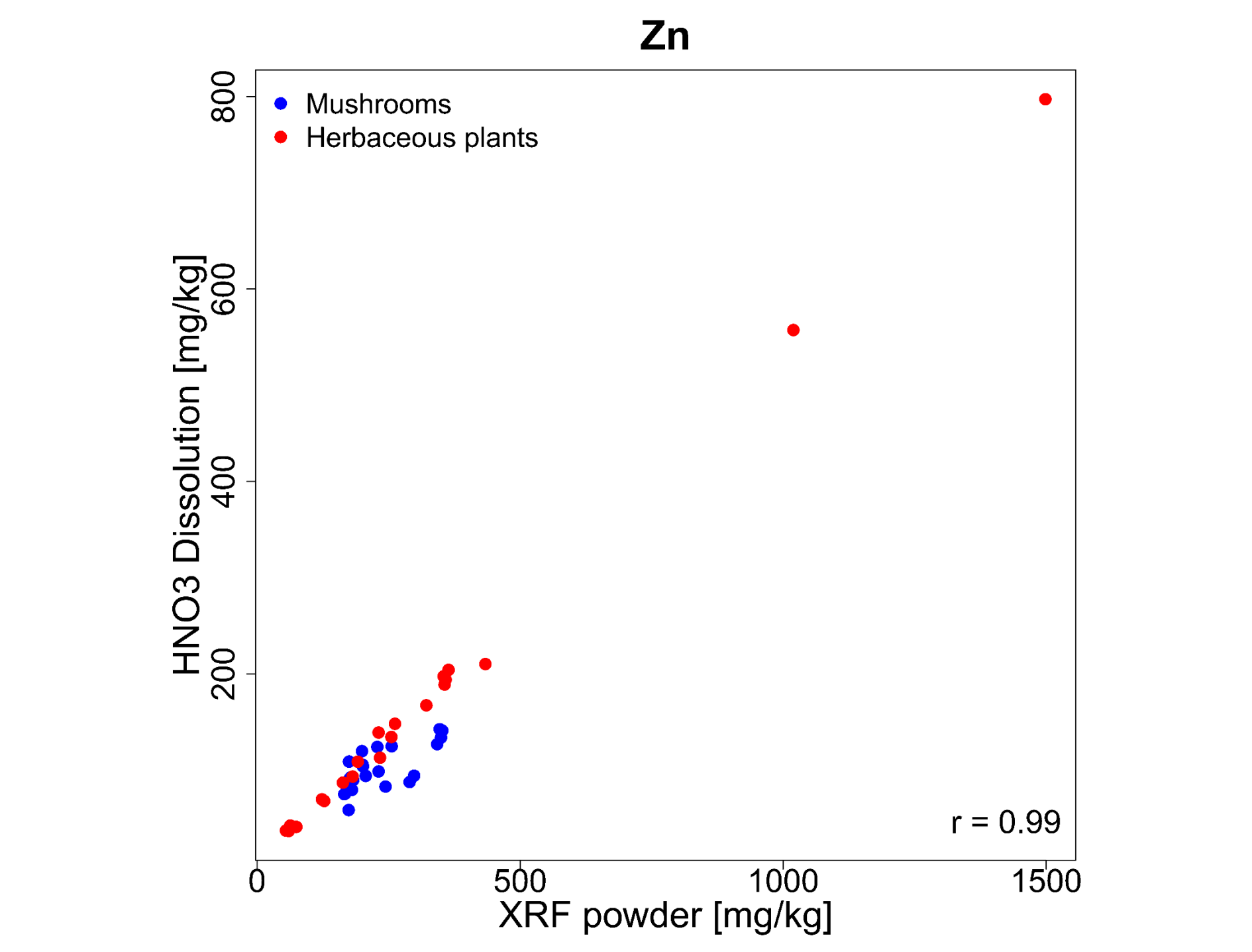
Dried – crushed

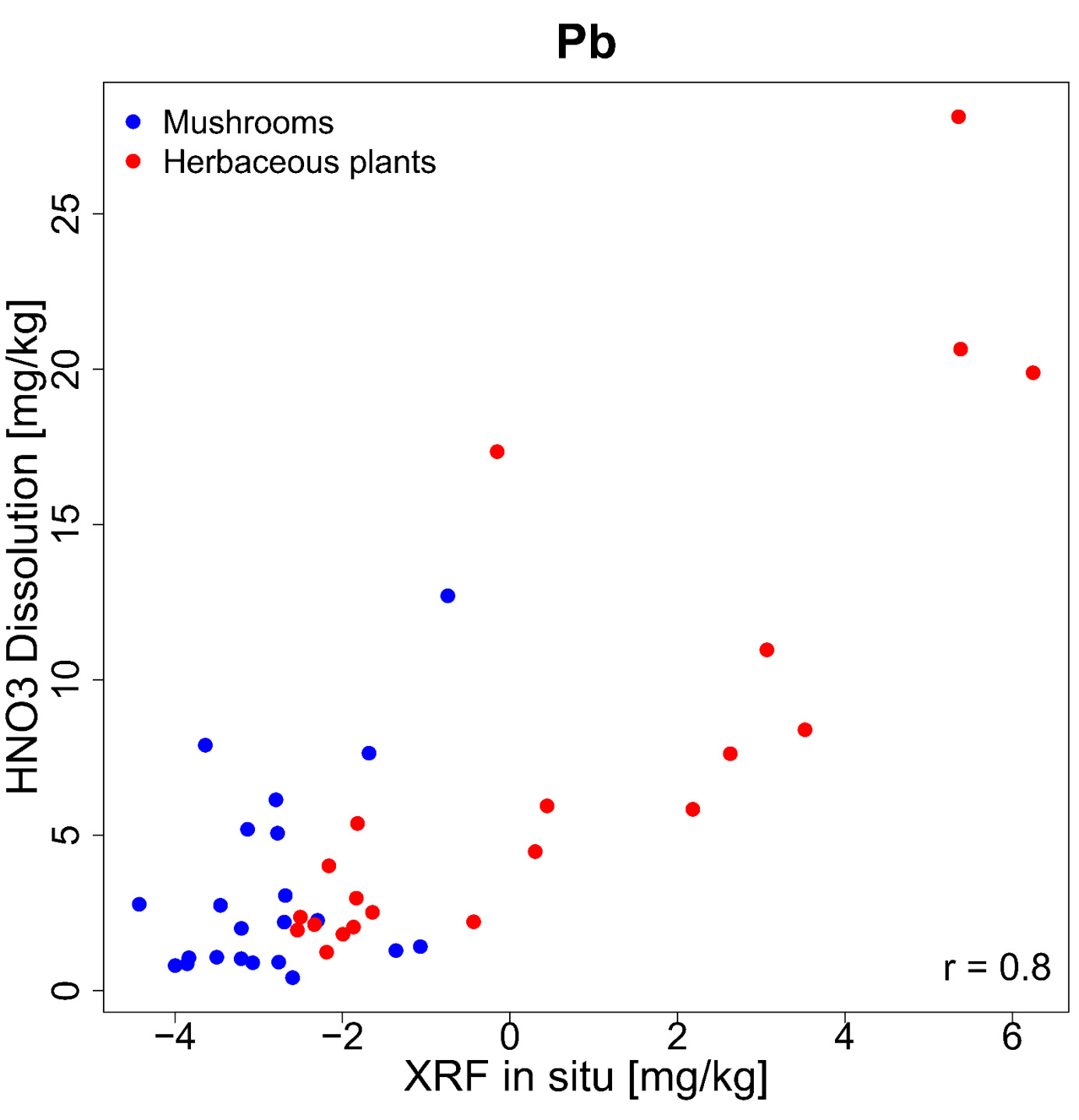
HNO_3 digestion + ICP

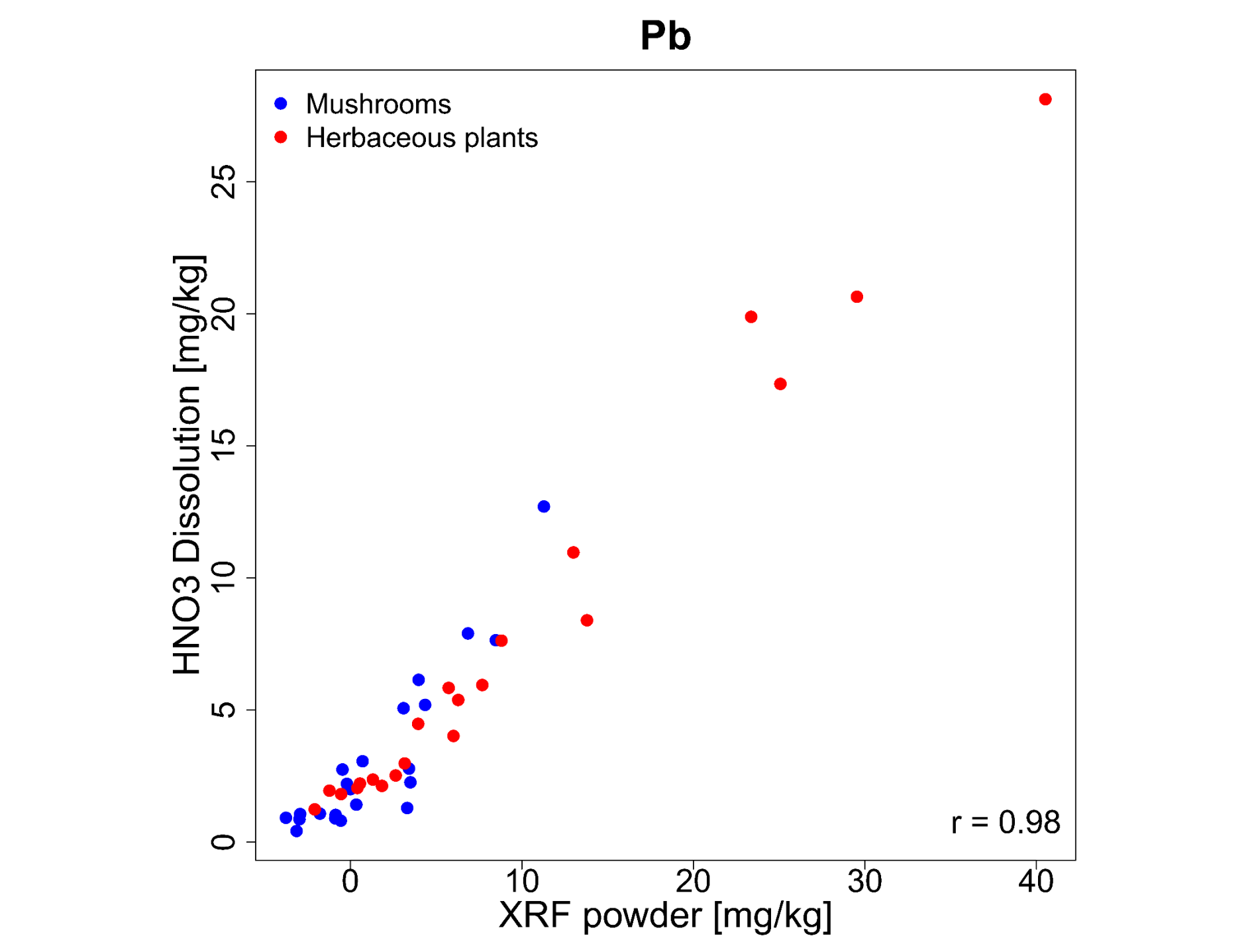
Fresh *in situ*

Dried – crushed


Zn
Mushrooms
Herbaceous plants
HNO3 Dissolution [mg/kg]
800
600
400
200
0
50
100
150
200
250
XRF in situ [mg/kg]
r = 0.93


Zn
Mushrooms
Herbaceous plants
HNO3 Dissolution [mg/kg]
200
400
600
800
0
500
1000
1500
XRF powder [mg/kg]
r = 0.99


Pb
Mushrooms
Herbaceous plants
HNO3 Dissolution [mg/kg]
0
5
10
15
20
25
−4
−2
0
2
4
6
XRF in situ [mg/kg]
r = 0.8


Pb
Mushrooms
Herbaceous plants
HNO3 Dissolution [mg/kg]
XRF powder [mg/kg]
r = 0.98
0
5
10
15
20
25
0
10
20
30
40

Correlation with reference protocol

Metal	Fresh	Powder
Cd	0.17	0.89
Cu	0.52	0.97
Pb	0.8	0.98
Zn	0.93	0.99

Correlation with reference protocol

Metal	Fresh	Powder
Cd	0.17	0.89
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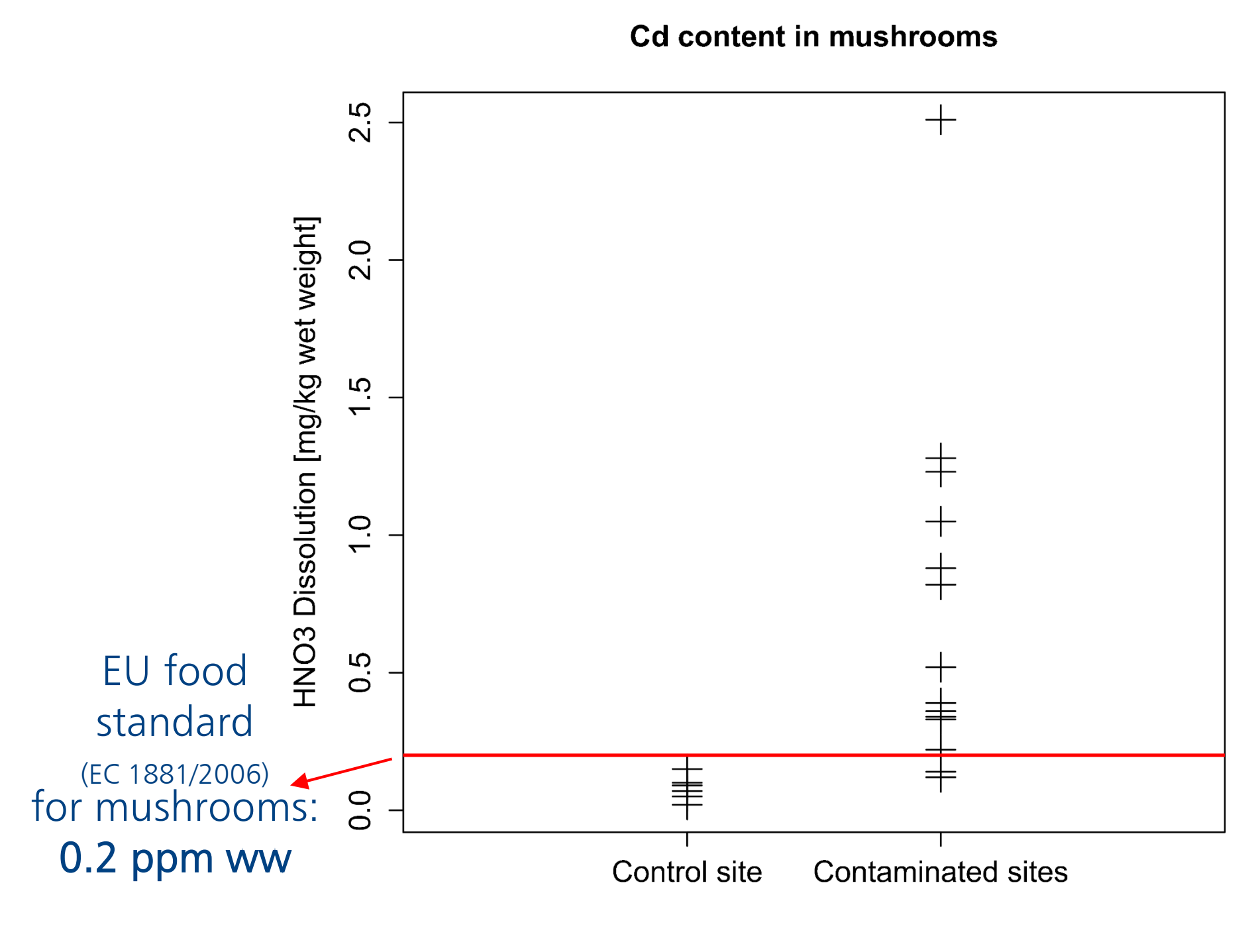
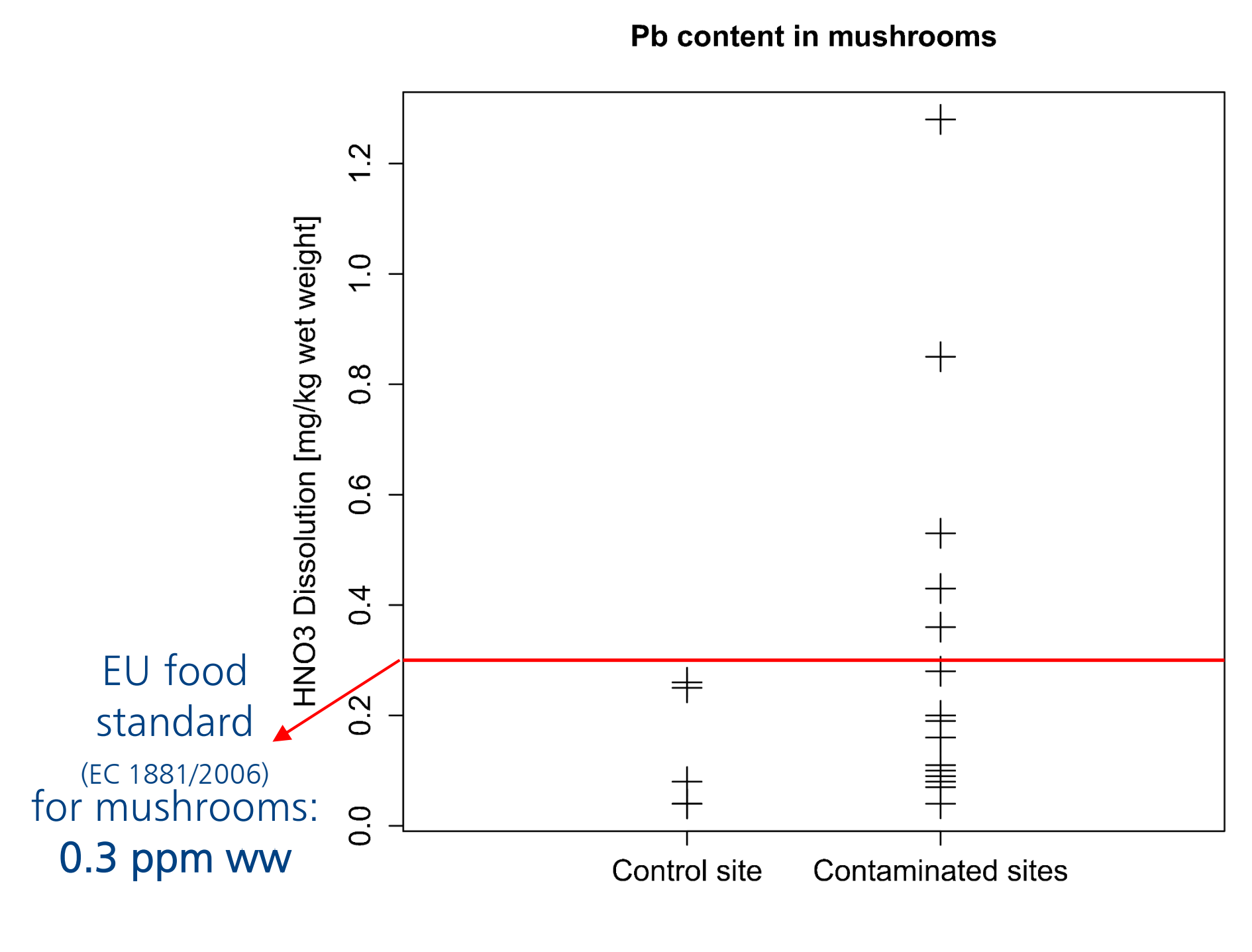
Zn	0.93	0.99

As, Ni, Cr : reference protocol ~ LQ

Cd content in mushrooms
HNO3 Dissolution [mg/kg wet weight]
0.0
0.5
1.0
1.5
2.0
2.5
Control site
Contaminated sites


Cd content in mushrooms
HNO3 Dissolution [mg/kg wet weight]
0.0
0.5
1.0
1.5
2.0
2.5
Control site
Contaminated sites
EU food standard
(EC 1881/2006)
for mushrooms:
0.2 ppm ww

Pb content in mushrooms
HNO3 Dissolution [mg/kg wet weight]
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Control site
Contaminated sites


Pb content in mushrooms
HNO3 Dissolution [mg/kg wet weight]
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Control site
Contaminated sites
EU food standard
(EC 1881/2006)
for mushrooms:
0.3 ppm ww

Take home message

pXRF = promising quick low cost protocol for metal measurement in organic matrices

- **Fresh** in situ : screening

- **Dried & crushed** : similar to reference protocols (acid digestion + ICP)

Perspectives

- Low cost survey to delineate areas where mushrooms shouldn’t be collected

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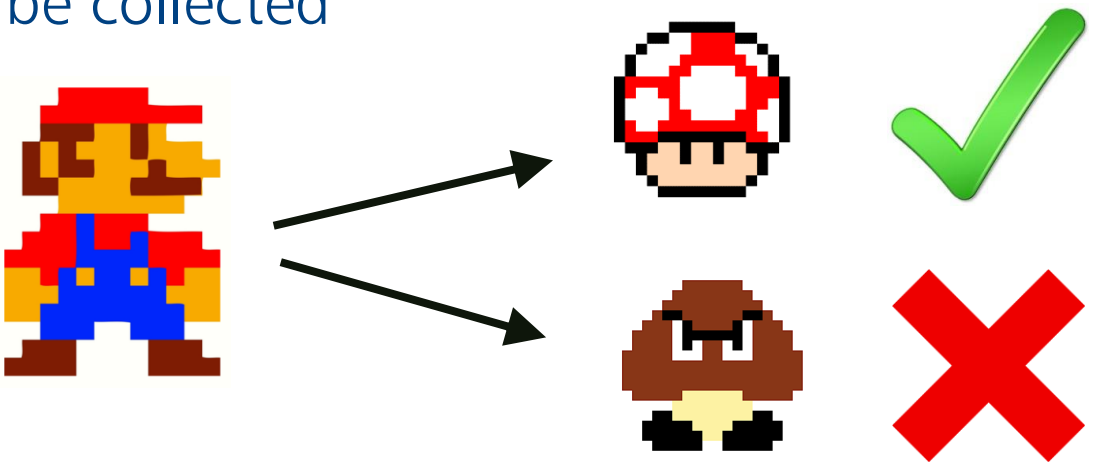
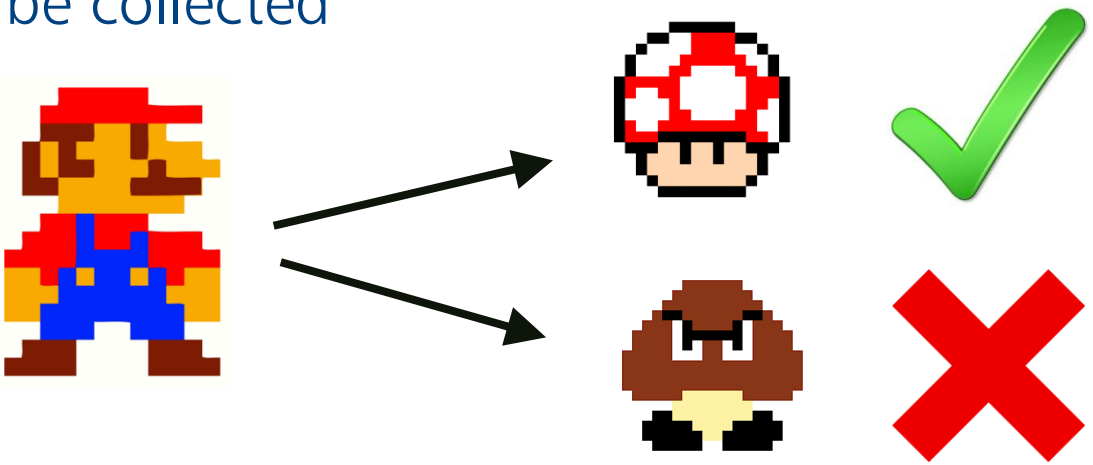
- Low cost survey to delineate areas where mushrooms shouldn’t be collected



Perspectives

- Low cost survey to delineate areas where mushrooms shouldn’t be collected



- Low cost protocol for risk assessment in vegetable gardens or in pasture land

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