Sara Pelaez, University of Limerick, Ireland.

Ronan Courtney (University of Limerick),

Olaf Schmidt (University Collegue Dublin)

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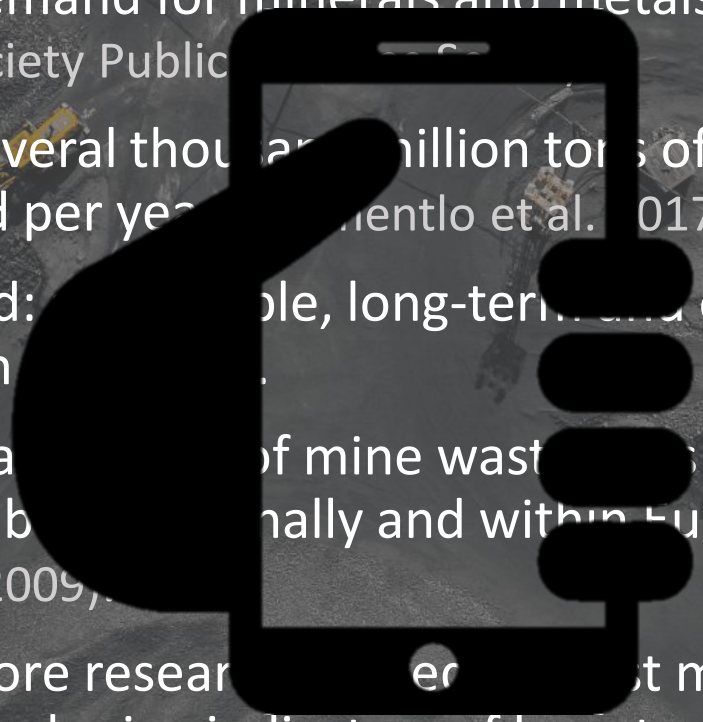
Soil macrofauna and mesofauna diversity in rehabilitated mine tailings

The problem

- Population growth, technological transitions are creating increasing demand for minerals and metals (Boodworth, 2018 at Geological Society Public
- In Europe, several thou ar illion to s of metal mine waste are produced per ye ientlo et al. 017).
- Industry need: ble, long-ter and effective rehabilitation
- Effective reha f mine wast is a legislative requirement b nally and with urope (CD 2006/21/EC; SI No. 566 of 2009).
- Scientists: more resear er t management practises, developing indicators of long-term rehabilitation success.



The state of the art

Rehabilitation assessment gaps

Why looking at soil fauna?

- Traditionally, restoration assessment focuses on: **monitoring aboveground vegetation**.
- Soil faunal diversity influence plant development, succession and soil physical properties (Frouz et al. 2006; Frouz et al. 2007; Biederman et al. 2008; Courtney et al. 2014; Courtney et al. 2018; Di Carlo et al. 2019).
- Soil fauna are **critical for rehabilitation strategies** to become **sustainable.**

Rehabilitation assessment

Why looking at soil fauna?

- Three important meso and macrofauna **ecosystem engineers**:
  - **Earthworms**.
  - **Springtails (Collembola)**.
  - **Ants**.

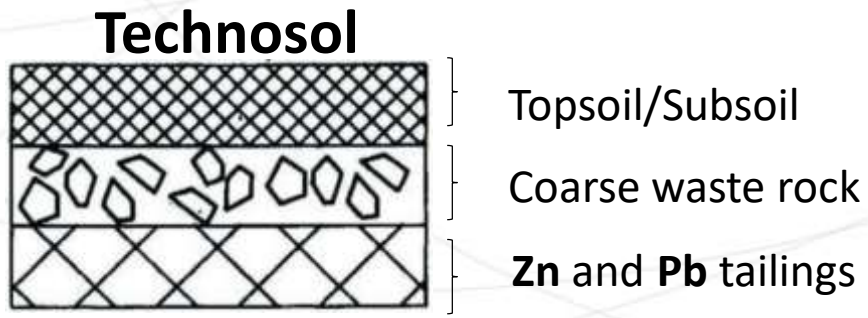
Objectives

Are soil invertebrates diversity and abundance a good indicator of rehabilitation success?

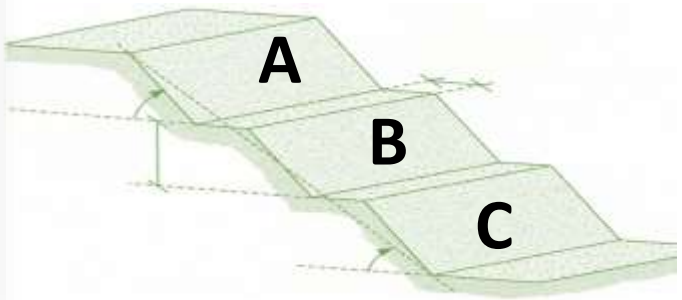
- To identify **key soil faunal groups** in a chronosequence (5, 15, 30 years) of rehabilitated mine tailings.
- Biodiversity indexes: Simpson, Shannon-Wiener, Evenness and Richness to evaluate rehabilitation success.

Study site

- Study site: metalliferous tailings.
  - Location **A** – 5 years
  - Location **B** – 15 years
  - Location **C** – 30 years



Modified from: Palmer, 2006.



Methodology

- Sampling methods: D-vac, pitfall traps and hand-sorting of earthworms.
  - Record number of individuals, July-August and November 2020.
  - Identification of samples, morpho species and species level.

Results – Biodiversity indexes

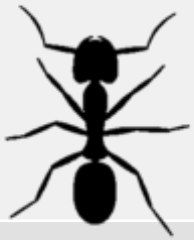
BIODIVERSITY INDEXES				
LOCATION	**Simpson (D)**	**Shannon-Wiener (H)**	**Evenness**	**Richness**
A	**0,065**	**3,080**	**0,717**	**39**
B	**0,113**	**2,802**	**0,653**	**42**
C	**0,134**	**3,055**	**0,712**	**48**

Simpson Index:
0 very high diversity,
1 very low diversity

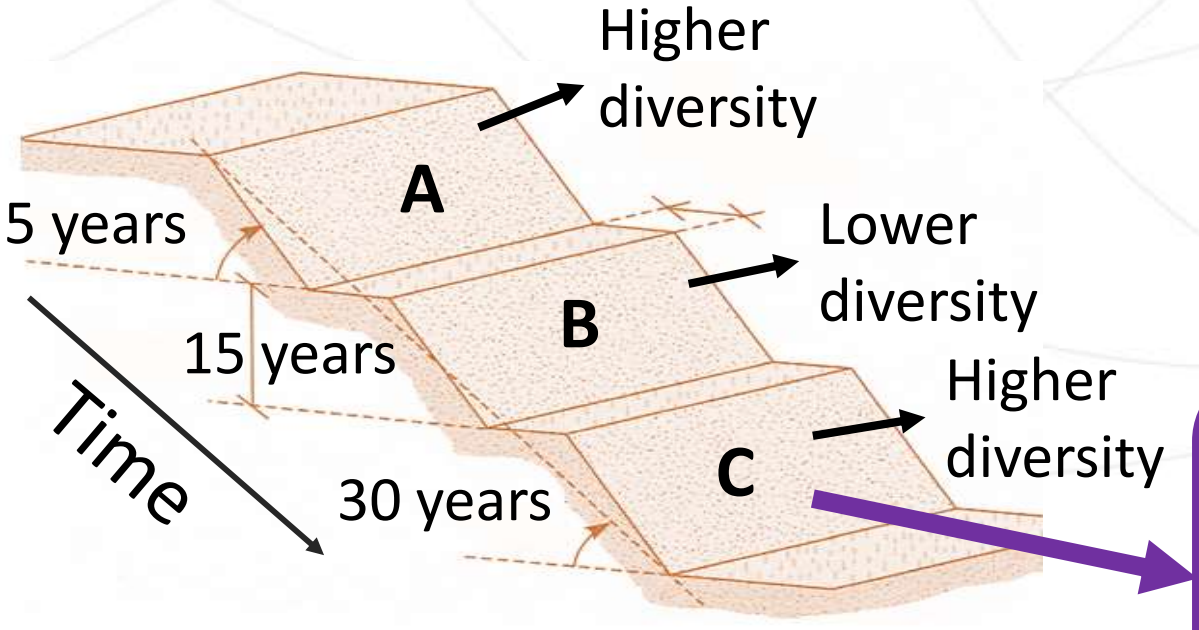
Shannon Index:
1.5 very low diversity
3.5 very high diversity.

Evenness:
0 no evenness
1 complete evenness

Results – Ecosystem engineers

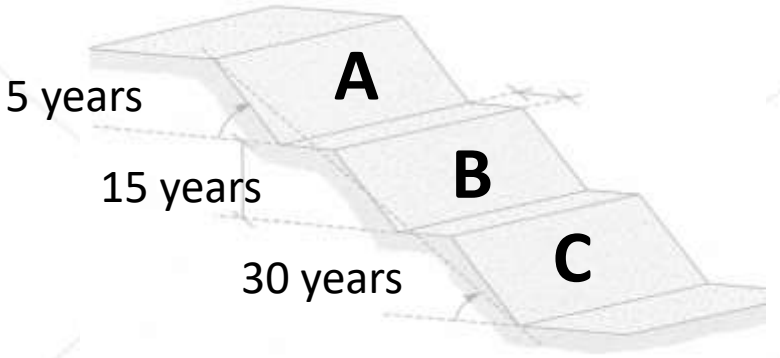
Order	Family	Species	Abundance		
			A - 5 years	B - 15 years	C - 30 years
Collembola 	Orchesella	*m1*	-	16	9
	Orchesella	*m2*	-	-	9
	Tomoceridae	*m1*	3	50	19
	Isotomidae	*m1*	26	-	-
	Isotomidae	*m2*	-	5	5
	Isotomidae	*m3*	2	-	-
	Isotomidae	*m4*	-	25	18
Hymenoptera	Formicidae	*Myrmica m1*	-	86	152
Annelids	Lumbricidae	*All.chl*	13	1	7
	Lumbricidae	*Ap.calg*	7	5	26
	Lumbricidae	*Lum.rub*	4	3	13
	Lumbricidae	*Ap.ros*	-	7	9
	Lumbricidae	*Oct.cyan*	-	1	3

Summary of results



Ecosystem engineers

Discussion



- How do we explain these results?

Early stage of succession

Location A

Old stage of succession

Location B

Conclusions and next steps

Are soil invertebrates diversity and abundance a good indicator?

- Biodiversity indexes alone are **not a good indicator** of rehabilitation success.
- Biodiversity studies are not transferable to industry since they requires large number of taxonomy specialists and sampling effort.
- **Next steps** for rehabilitation assessment:
  - Soil food-web and soil functions.
  - Ecosystem engineers as good long-term indicators of rehabilitation success.

Thanks,

Sara Pelaez Sanchez
Department of Biological Science
Faculty of Science & Engineering,
Bernal Institute, University of Limerick.
Sara.Pelaez@ul.ie

Ronan Courtney
Department of Biological Science
Faculty of Science & Engineering,
Bernal Institute, University of Limerick.

Olaf Schmidt
School of Agriculture and Food
Science, University College Dublin.

Science Foundation Ireland sfi For what's next