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Soil health – Does it apply to polluted soils?

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Five EU Missions

EU missions are commitments to solve some of the greatest challenges facing our world:

- Climate adaptation
- Climate neutral Cities
- Mission Soil
- Cancer
- Restore waters

Soil monitoring directive

Objective: To have all soils in a healthy condition by 2050, in line with the EU Zero Pollution ambition.

Puts in place a solid and coherent soil monitoring framework for all soils across the EU.

The Directive lays down measures on:

(a) monitoring and assessment of soil health

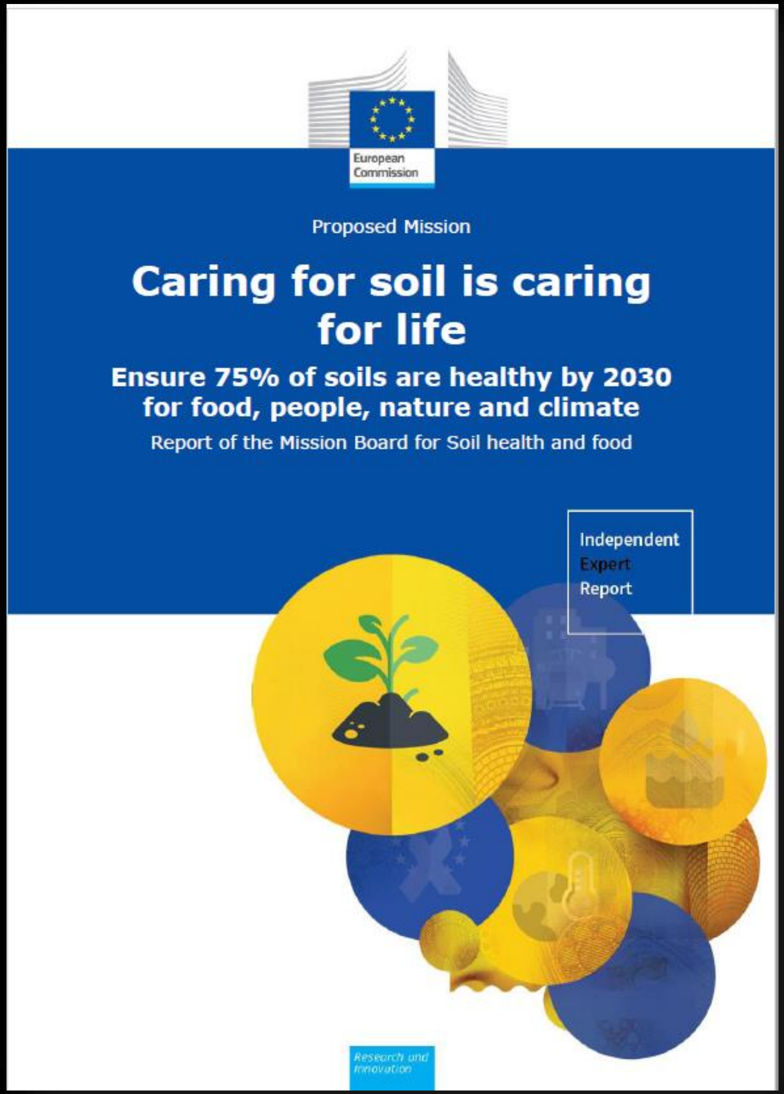
(b) sustainable soil management

(c) contaminated sites

Concerns a range of land uses - agriculture, forestry, urban areas and natural/semi-natural areas

EU's goals for soil health
(Today, 60-70 % of EU soil has poor soil health.
Within 2023, 70 % should have good soil health)

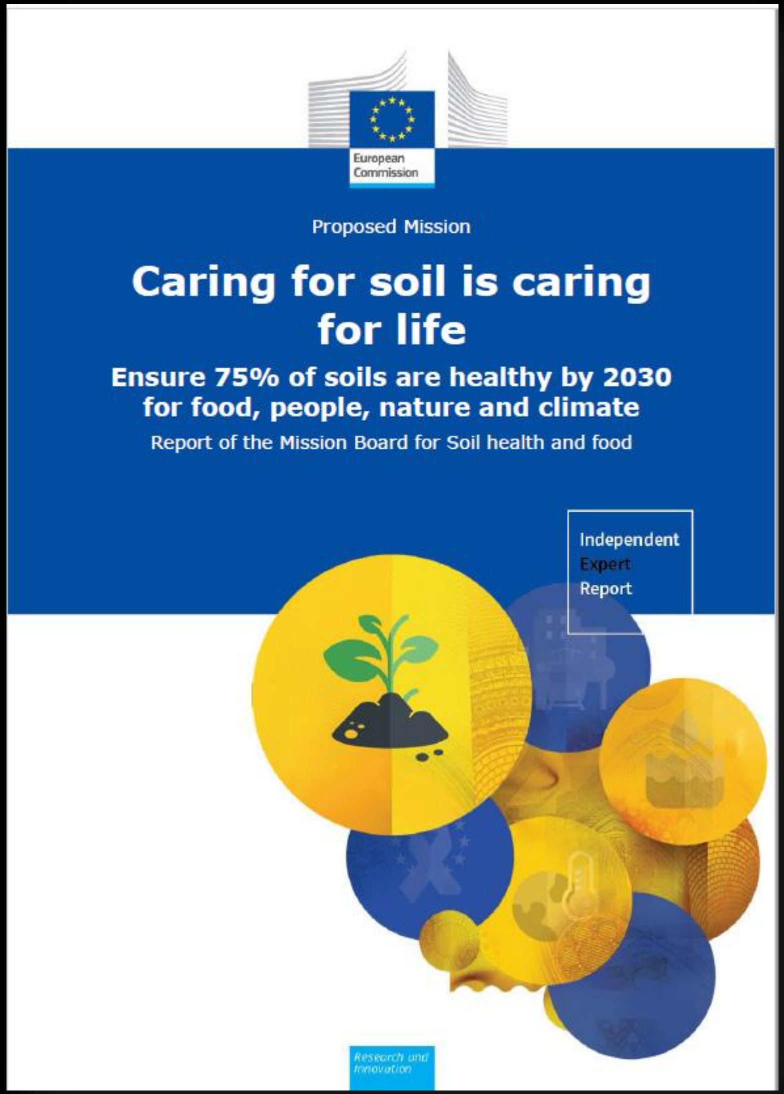
1. Reduce soil degradation, incl. salinization and desertification
2. Conserve or increase soil C stocks
3. No soil sealing and reuse of urban soil
4. Stop soil pollution and restore polluted soils
5. Stop erosion for 30-50 % of vulnerable soil
6. Improve soil structure and improve soil as a habitat
7. Reduce EU's footprint on soil outside EU
8. Increase soil literacy



Soil health will be assessed regarding 8 specific challenges:

- Pollution and surplus of nutrients and salt
- Organic matter in soil
- Soil structure, density, sealing and erosion
- Biological activity and diversity
- Nutrient content and pH
- Vegetation cover
- Heterogeneity of the landscape
- Occurrence of forest

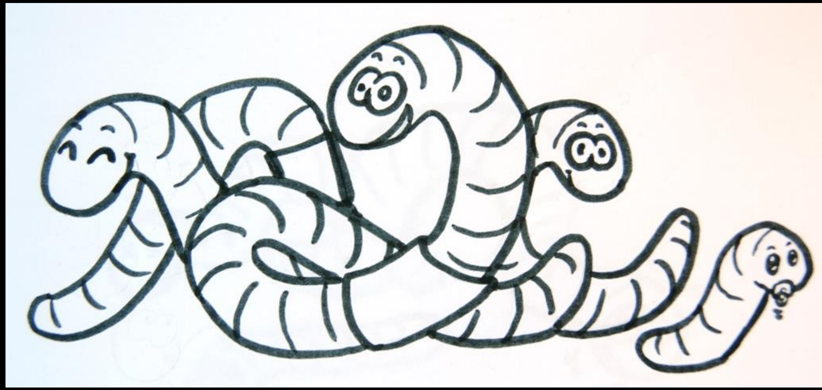
One out – all out



What is soil health?

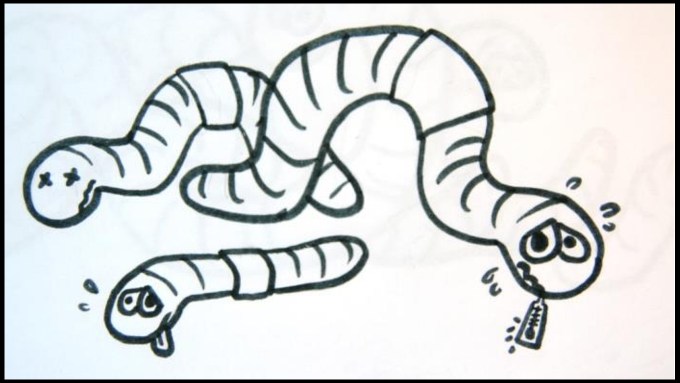
«Soil's capacity to deliver ecosystem services»

A catchy buzz word



Briefly:

- Produce healthy plants
- Purify and regulate water
- Recycle nutrients
- Prevent soil erosion and degrade/sequester pollutants
- Maintain soil carbon pool and biodiversity
- Green house gas emissions?



Soil health *vs.* soil quality

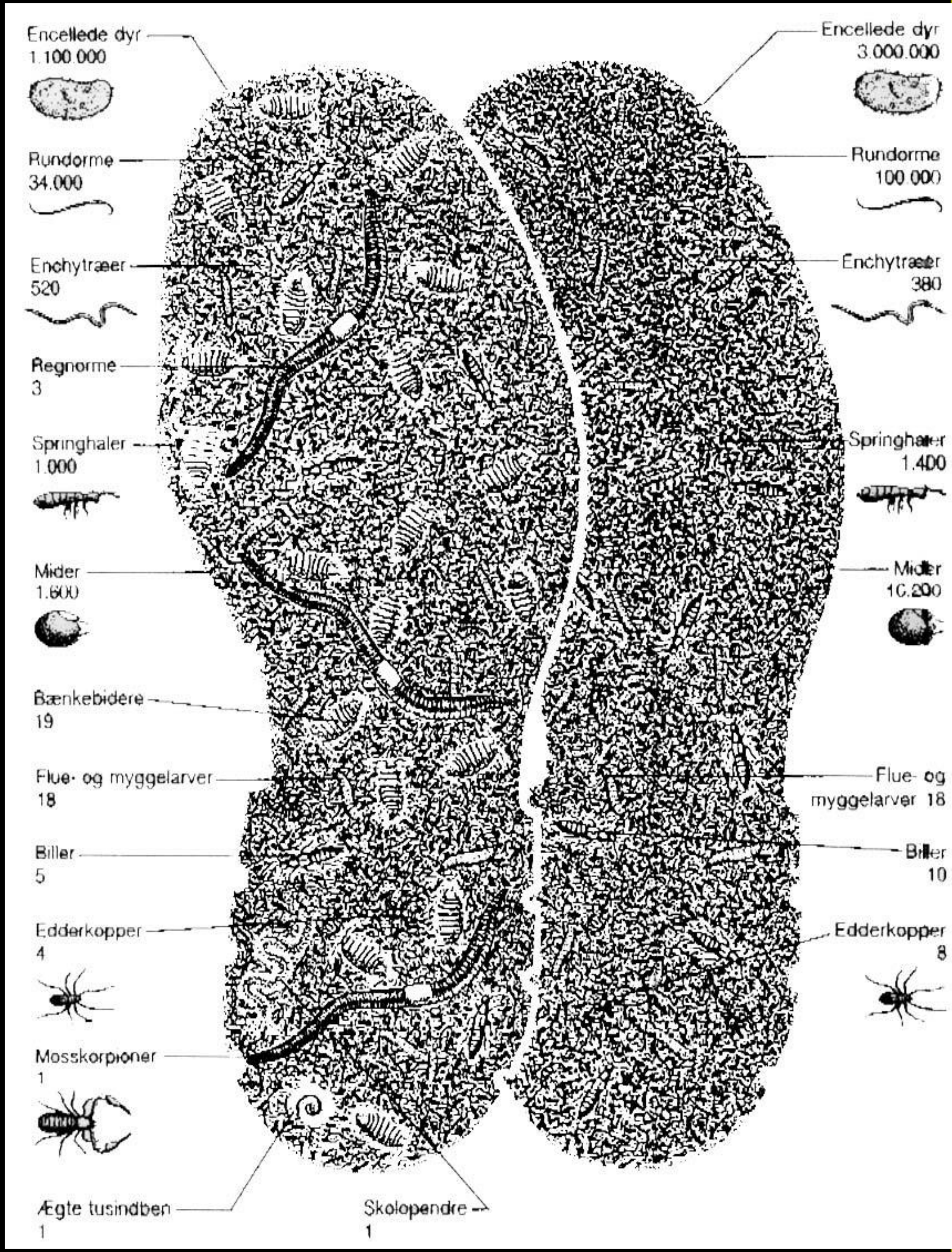
The difference is soil biota

Soil biota ensure:

- Breakdown and recycling of nutrients
- Breakdown of pesticides and organic pollutants
- Building and maintenance of soil structure
- Competitive reduction of patogens
- Soil and litter mixing

How to measure soil life?

- Activity
- Biomass
- Biodiversity
- Are all animals equal?
- Are sentinel organisms useful?
- Are functional outcomes the answer?



Biodiversity in soil

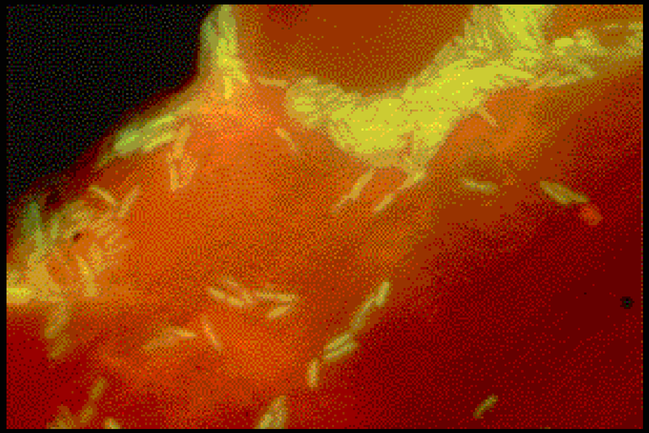
Soil is the World's most diverse ecosystem

Common to find 5-10.000 species in 1 g of soil

- >99 % are unculturable
- Large overlap for main functions (degradation)
- Low diversity for mycorrhizal fungi, rhizobia, denitrifying bacteria and a few others

What to measure?

What are they doing?



- Fragmentation and degradation (~99 %)
- At the same time: Aggregation, building pores, mixing
- Predators, pathogens, symbionts
- Nitrification, denitrification, methane production, methane oxidation...

But living conditions are meager:

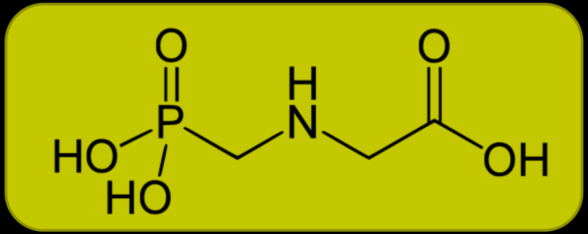
- All soil life is starving, most organism hibernate at all times
- Activity occurs around roots, in guts of mesofauna, and upon amendments with organic material (manure, litter)
- Activity depends on soil conditions (O_2, pH, temp.)

Peculiarities of polluted soils

- Polluted soils often lack food for soil biota (plants, organic inputs, N or other growth limiting nutrients)
- Polluted soils are often compact
- Pollutants may be toxic
- Soil organisms may develop tolerance
- Pollutants can represent new substrates for tolerant organisms, and even enhance biodiversity

But:

- Polluted soils will often never become entirely healthy soils
- A number of dilemmas may be foreseen



Soil health dilemmas

Agriculture:

- Tillage or herbicides?
- Organic vs. «organic light»
- Recycling to soil OK even when it pollutes?
- Are GHG emitting practices good if they boost soil biology?

Polluted sites:

- Are absolute soil concentrations valid metrics?
- Are measures that enhance biological activity good if they also enhance mobility of pollutants?

Conclusions

- The soil health focus may boost research on polluted soils
- Ample opportunities for restoration projects and studies of new pollutants (microplastics, antimicrobial resistance, …)
- Soil restoration efforts need to identify key organism groups for soil improvement and improve their living conditions
- Pollutant reduction will still be main focus

Thank you for your attention!

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