

STATE of KNOWLEDGE of SOIL BIODIVERSITY- Status, Challenges and Potentialities

GSP secretariat

Rosa Cuevas



GLOBAL SYMPOSIUM ON SOIL BIODIVERSITY | 19-22 April 2021

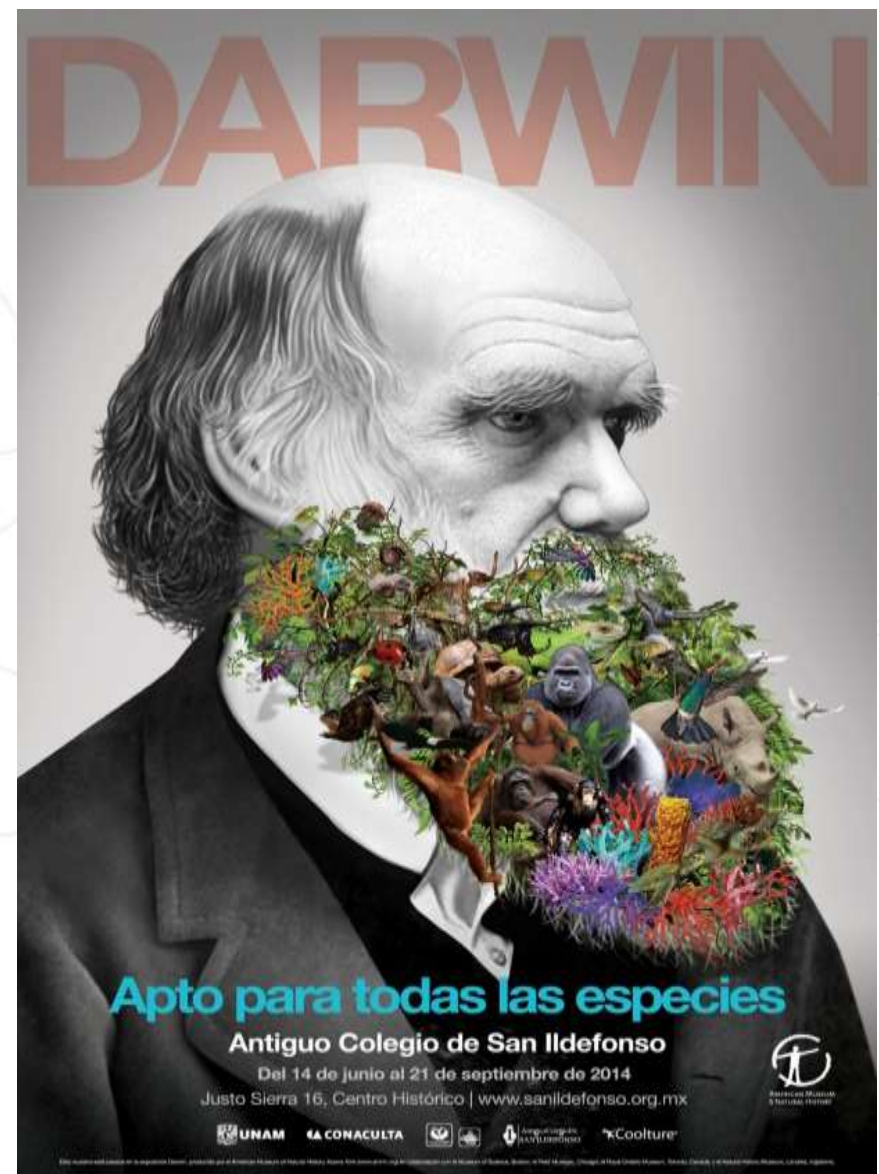
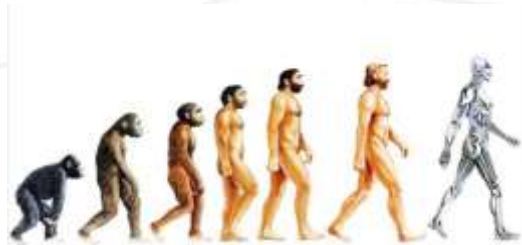
How many species are there in the world?

8.7 million species

Identified: 1.3 million

86 % terrestrial and 96 % marine not discovered

Only one species dominates and is transforming the planet!



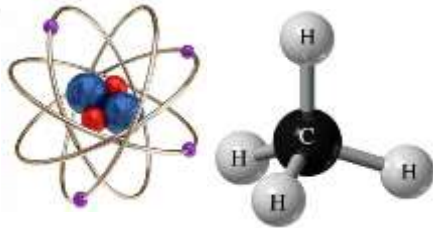
A little bit of history...

13.5 billion years



Matter, energy, time and space had their origin in the Big Bang. The account of these fundamental characteristics of our planet is called **Physics**

3000 years after its appearance



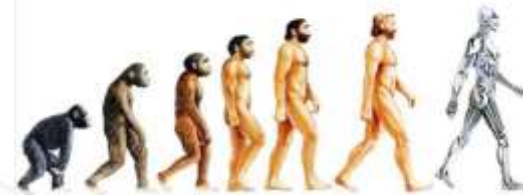
Matter and energy began to clump together into complex structures called atoms that later combined into molecules. The story of atoms, molecules and their interactions is called **Chemistry**

3.8 billion years ago



On a planet called Earth certain molecules combined to form particularly large and intricate structures called organisms. The story of organisms is called **biology**

70,000 years ago

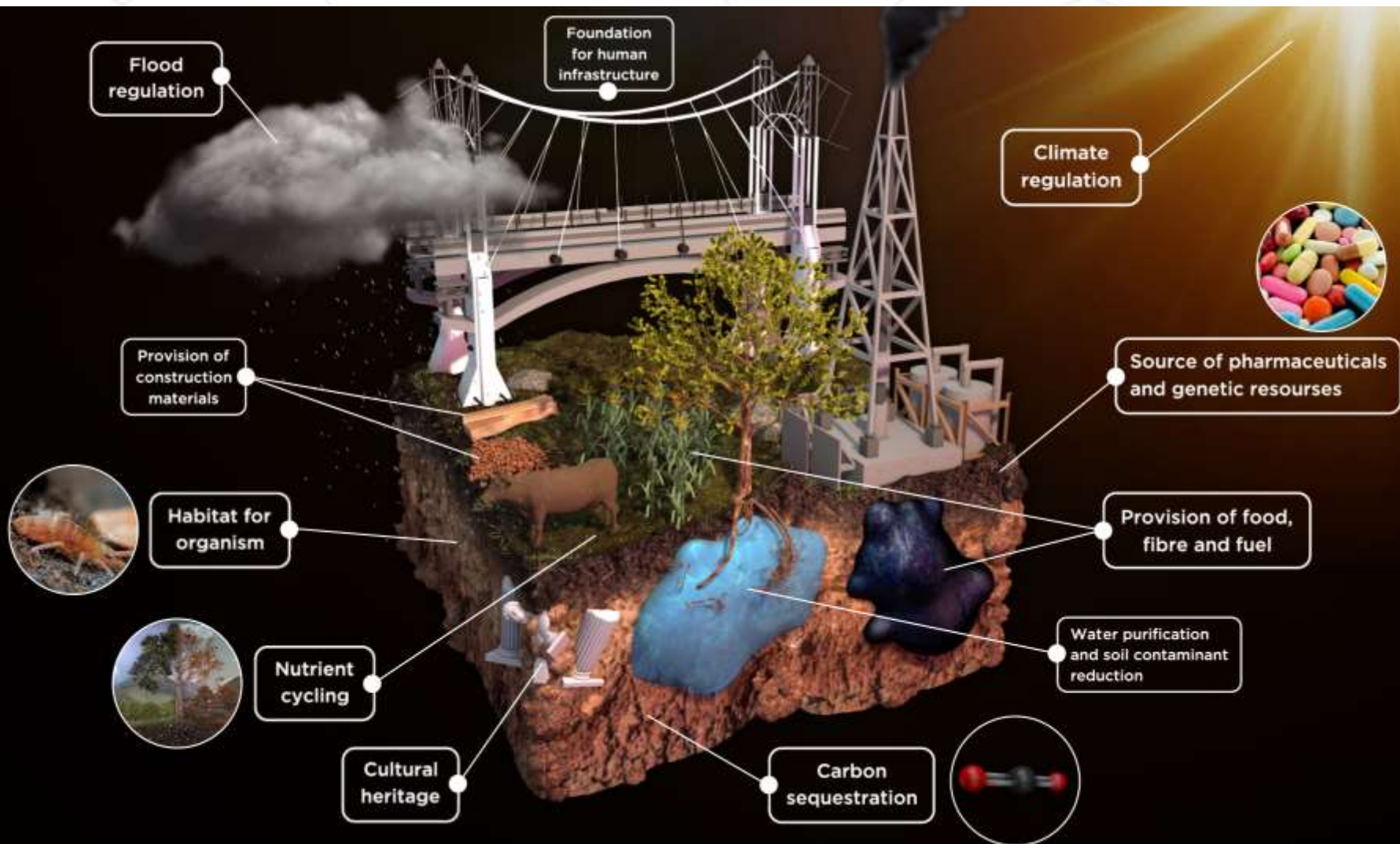


Organisms belonging to the species *Homo sapiens* began to form even more complex structures called cultures. The development of these cultures is called **History**

From Animals into Gods: A Brief History of Humankind
Yuval Noah Harari



Soil is a valuable natural capital, but.... one third of our global soils are degraded



The current global challenges



The current global challenges



The current global challenges



LOSS OF SOIL BIODIVERSITY



The current global challenges



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The current global challenges



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The current global challenges



LOSS OF SOIL BIODIVERSITY

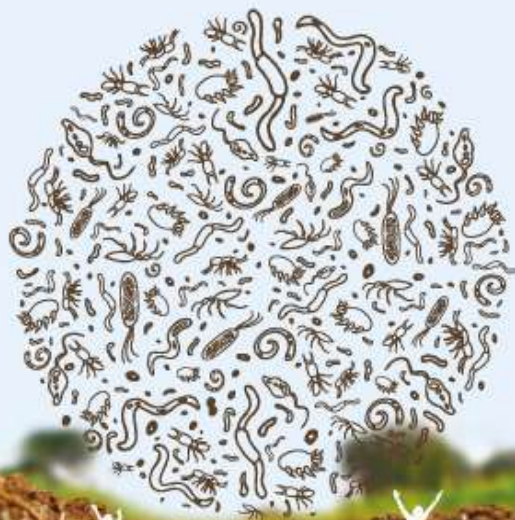




Food and Agriculture
Organization of the
United Nations

Report
2020

STATE of KNOWLEDGE of SOIL BIODIVERSITY



Status, challenges and potentialities

itps
INTERDISCIPLINARY
TECHNICAL PANEL ON SOILS



Convention on
Biological Diversity



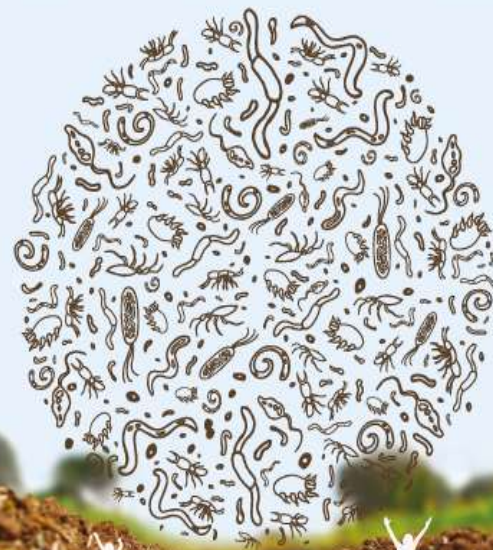
GLOBAL
SOIL BIODIVERSITY
INITIATIVE



Food and Agriculture
Organization of the
United Nations

Summary for
policy makers
2020

STATE of KNOWLEDGE of SOIL BIODIVERSITY



Status, challenges and potentialities

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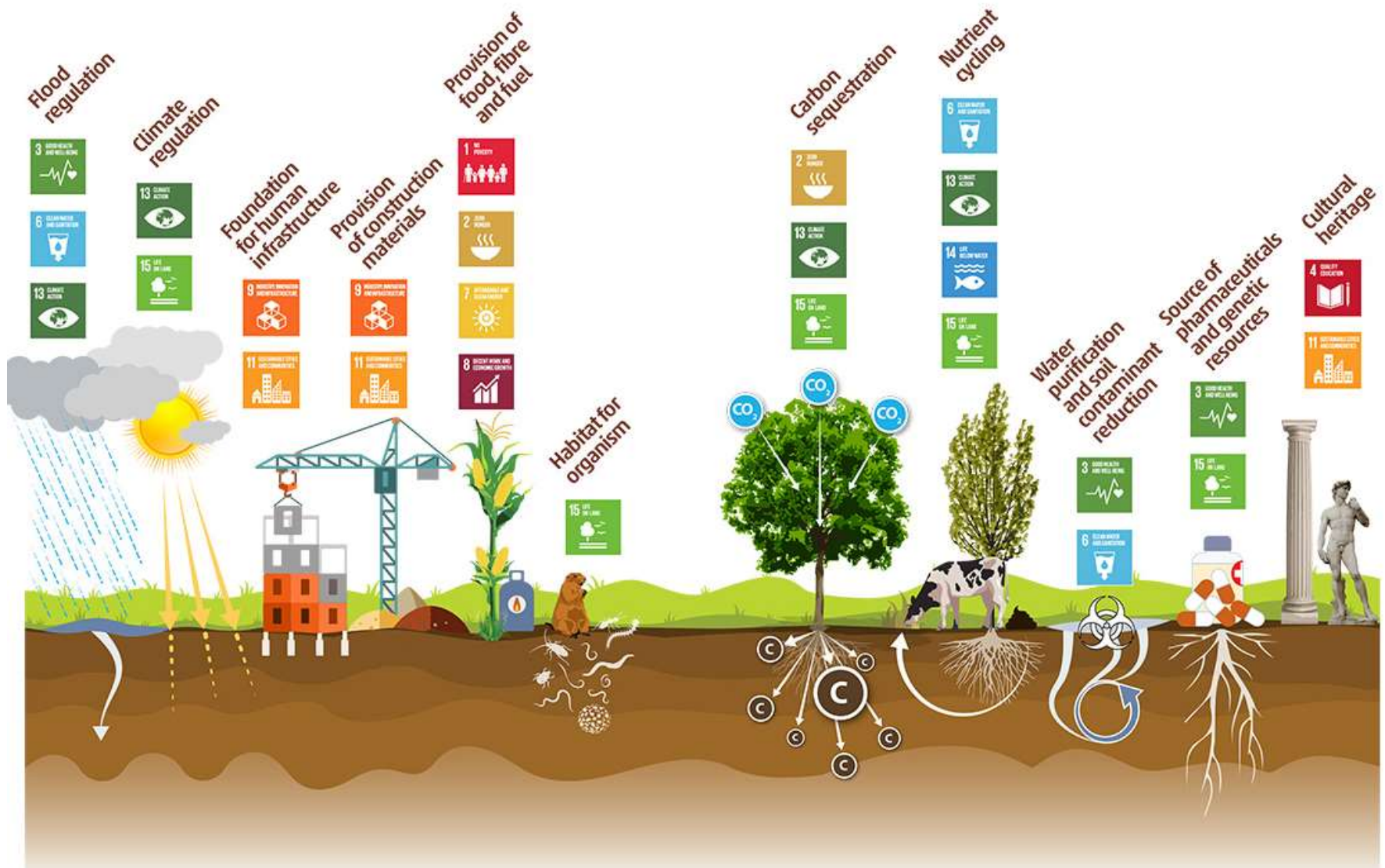


Convention on
Biological Diversity



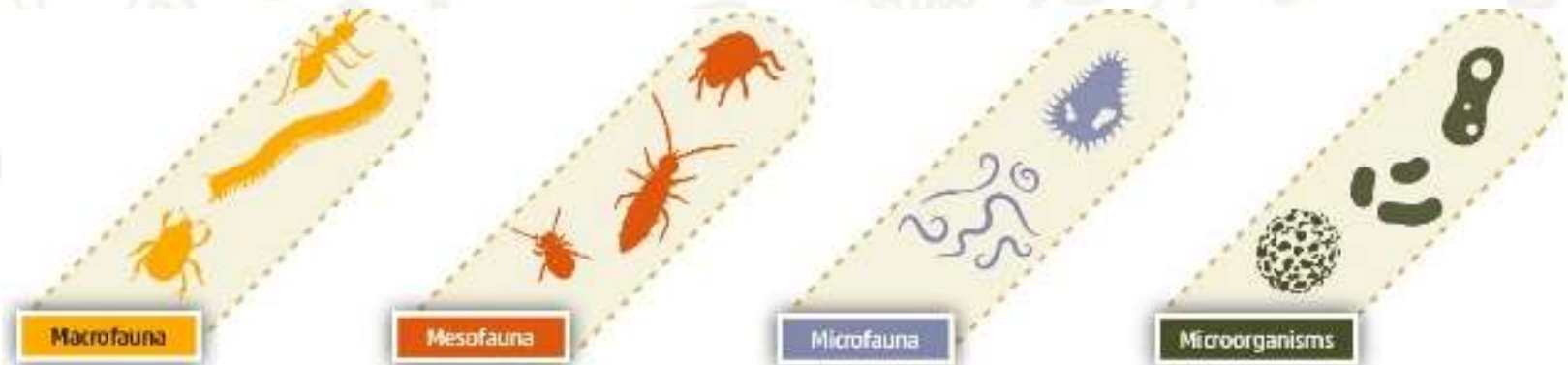
GLOBAL
SOIL BIODIVERSITY
INITIATIVE

A healthy soil is capable of providing most terrestrial ecosystem services, therefore contributing to achieve the SDGs and human well-being



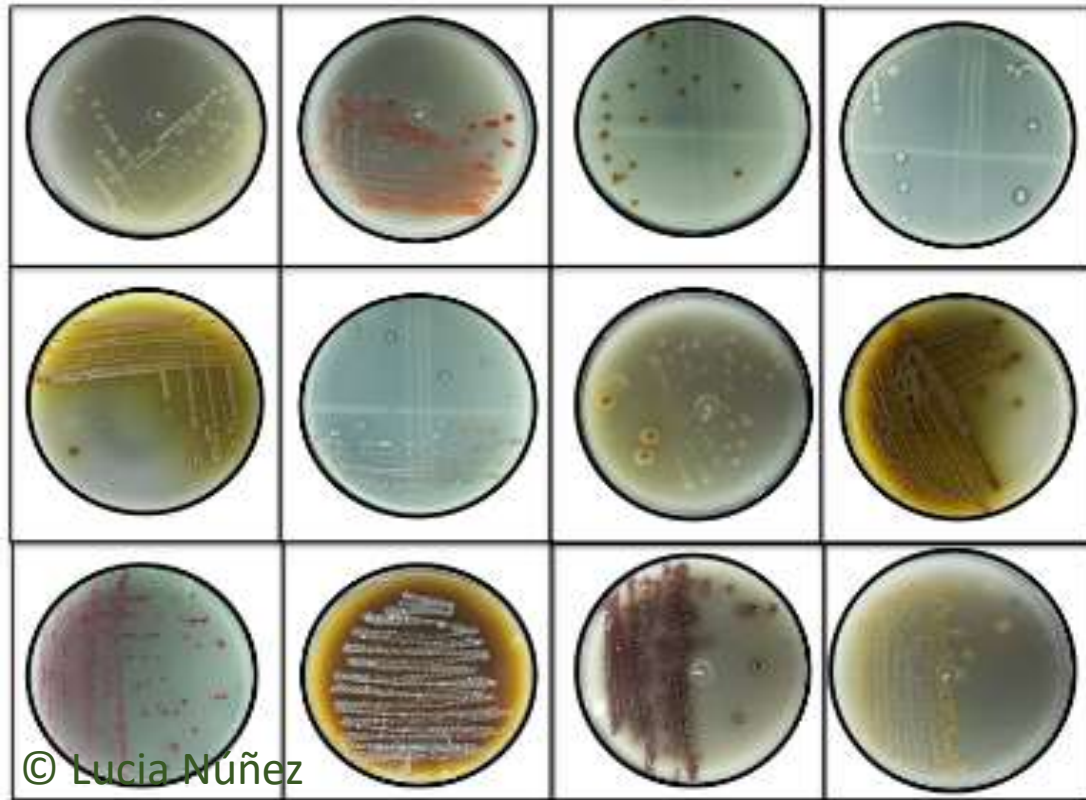
What is soil biodiversity?

We define soil biodiversity as the variety of life belowground, from genes and species to the communities they form, as well as the ecological complexes to which they contribute and to which they belong, from soil micro-habitats to landscapes.



World Soil Day

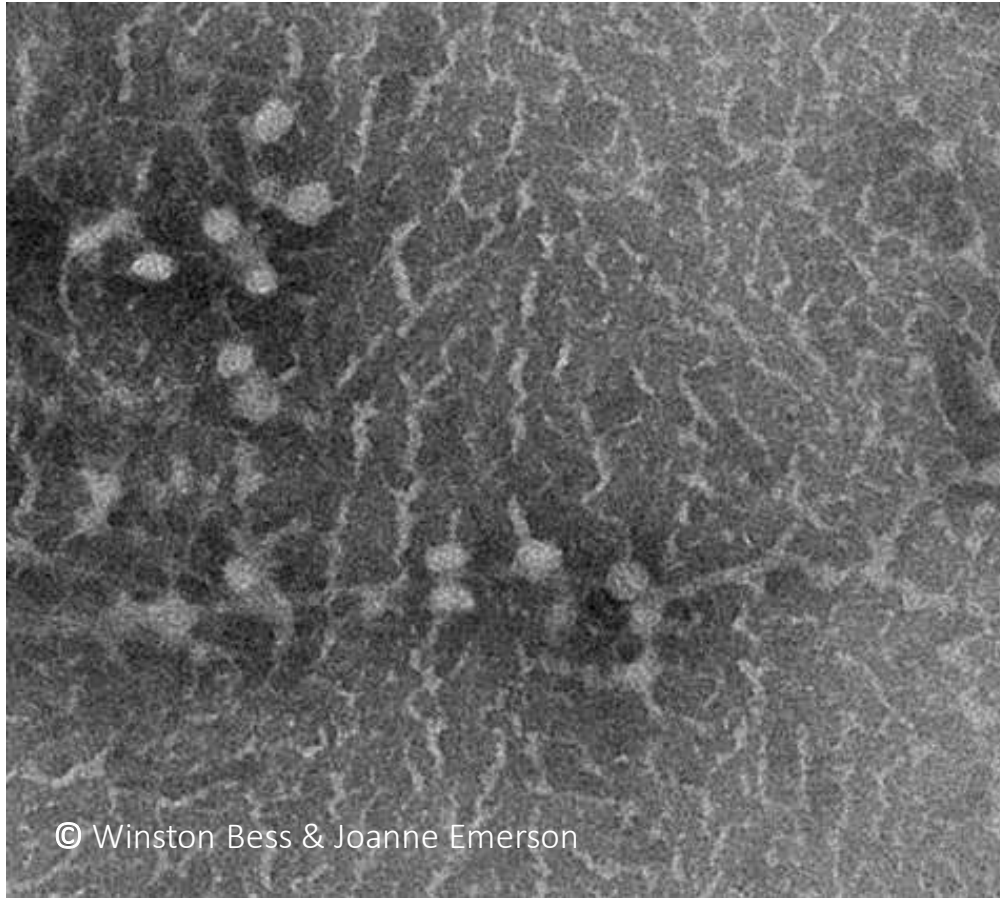
What is soil biodiversity?



What is soil biodiversity?



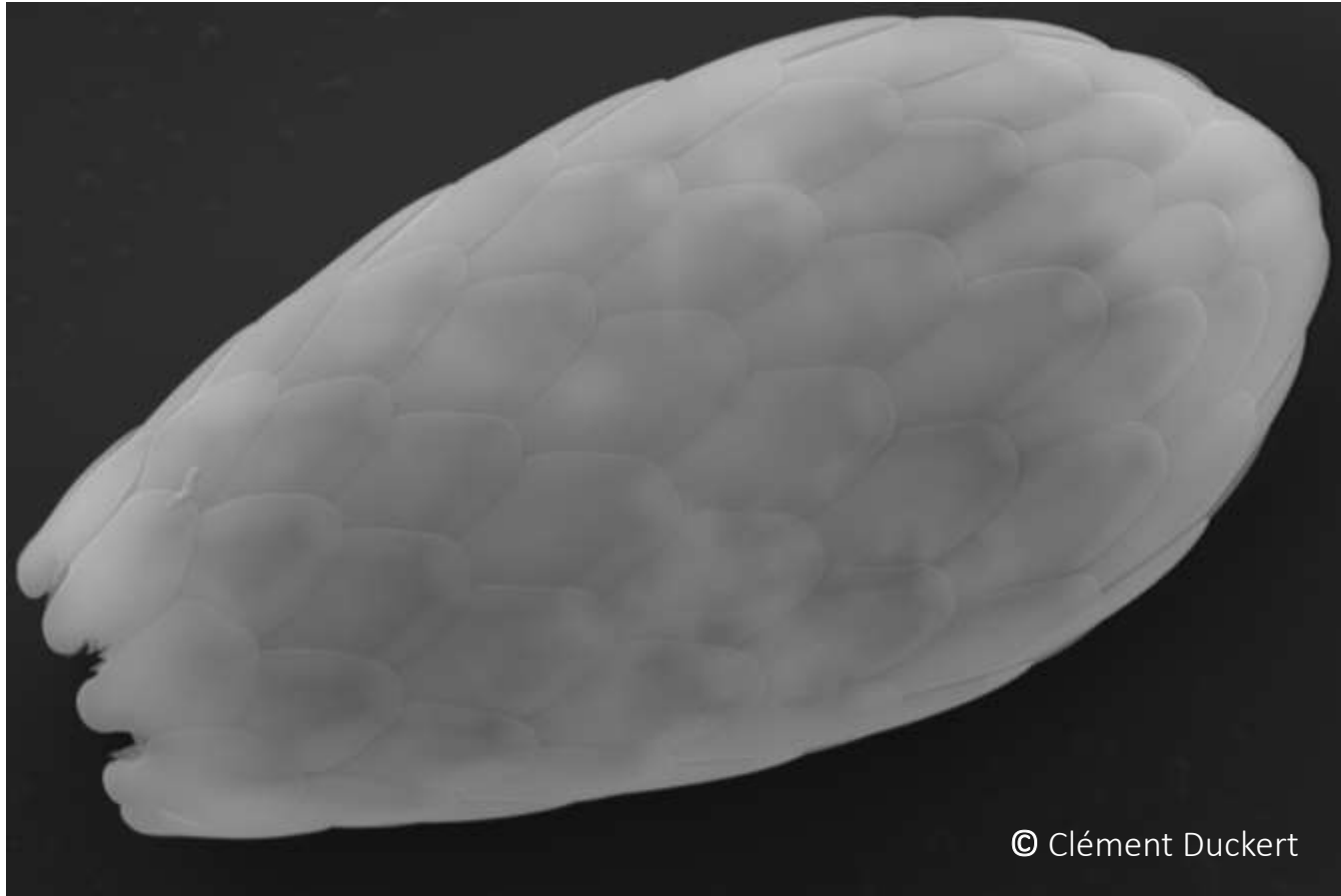
What is soil biodiversity?



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What is soil biodiversity?



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What is soil biodiversity?



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What is soil biodiversity?



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What is soil biodiversity?



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What is soil biodiversity?



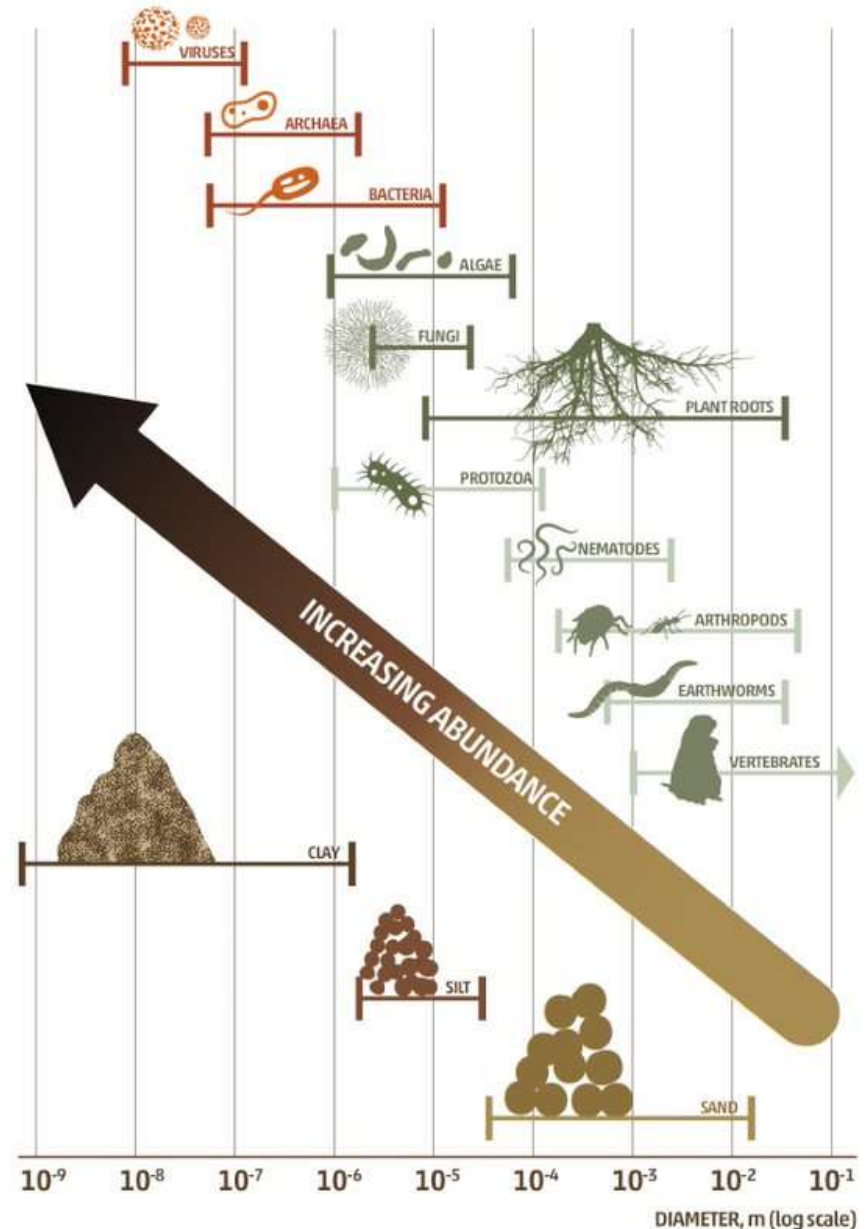
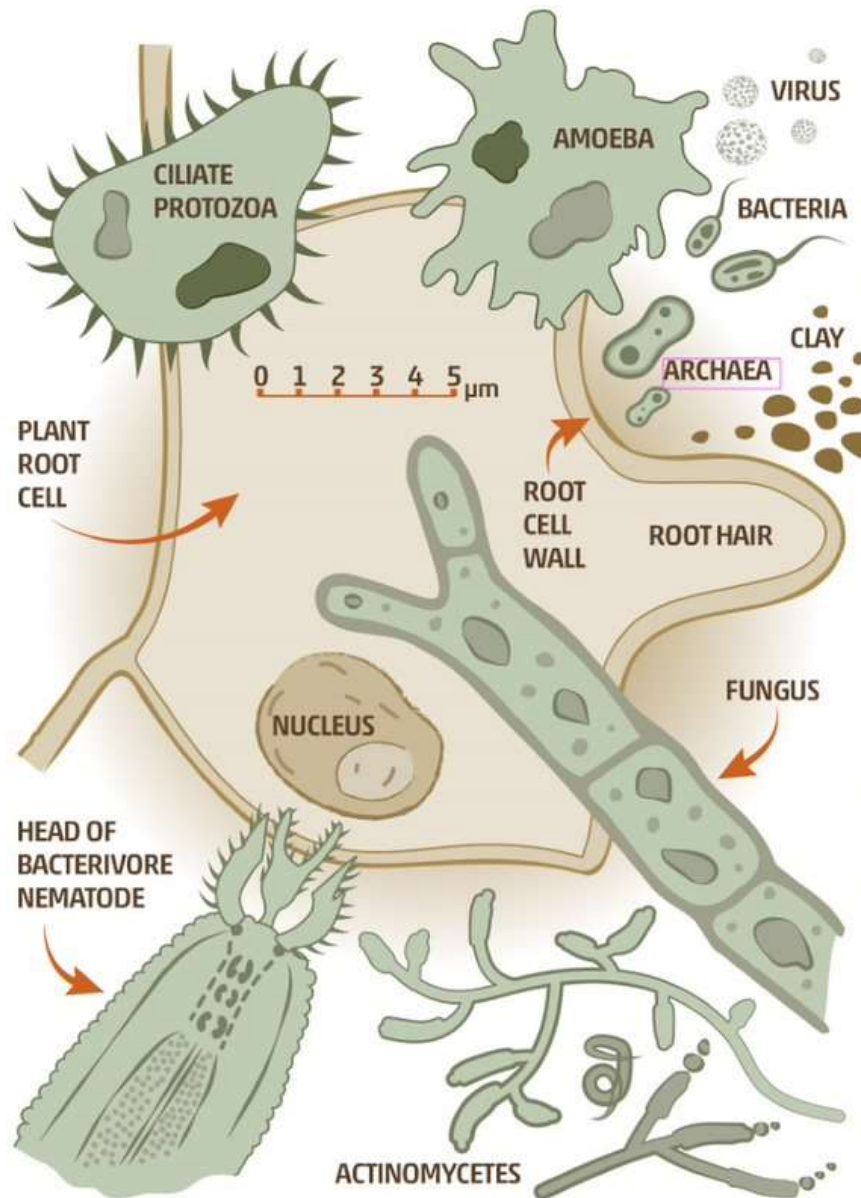
What do we know about soil biodiversity?

Soil diversity



- **Bacteria and Archaea:** 2.5×10^{30} cells.
- **Fungi:** 0.8-3.8 million species.
- **Nematodes:** 4×10^{20} individuals in soils alone.
- **Mites:** 20 000 described, 80 000 undescribed species.
- **Collembola:** 8 000 described species worldwide.
- **Earthworms:** 6 000 species, from 20 families
- **Termites:** 2 934 species in 282 genera.
- **Ants:** 20 000 species.

What do we know about soil biodiversity?

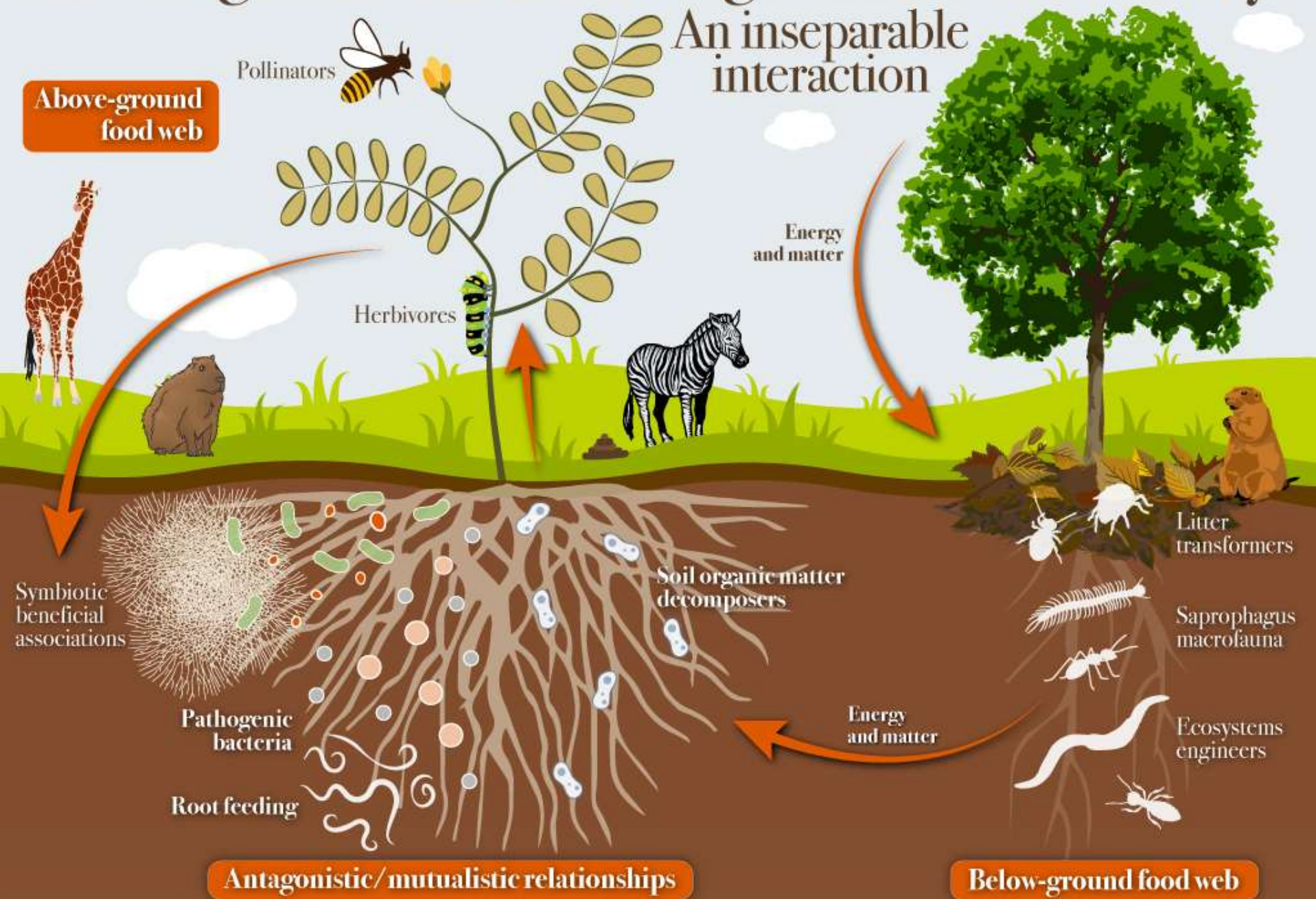


What do we know about soil biodiversity?



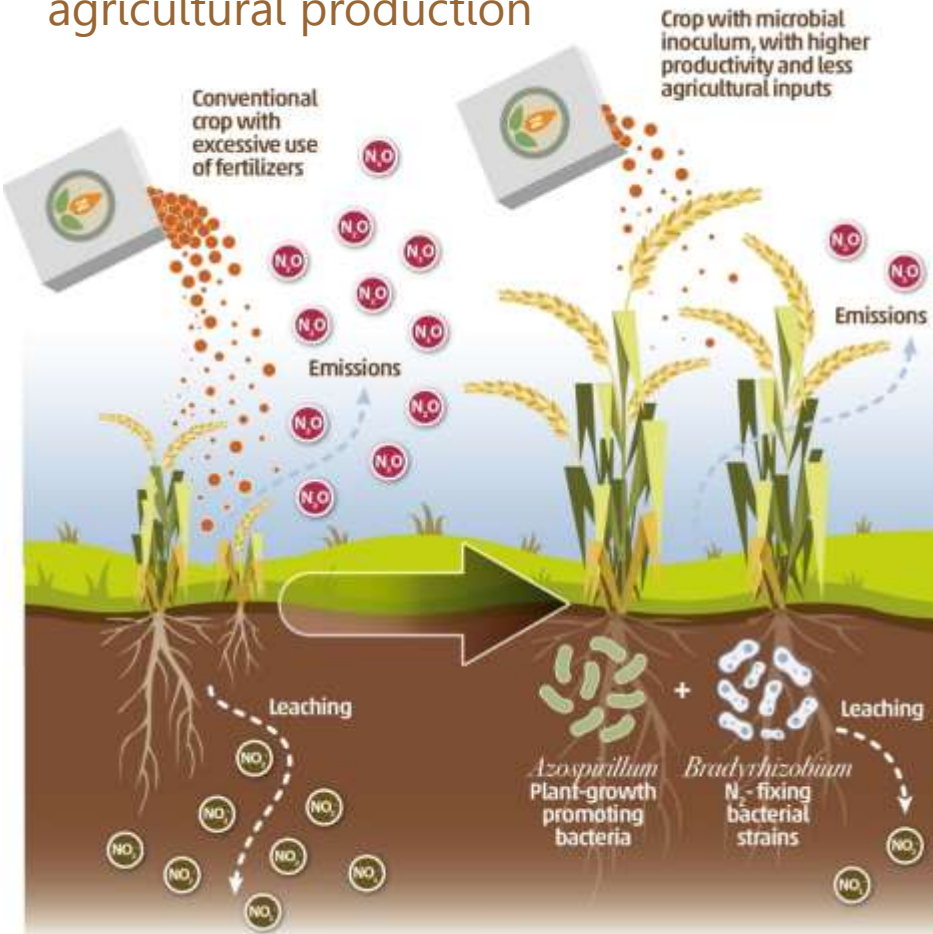
- More than 40% of living organisms in terrestrial ecosystems are associated during their life-cycle directly with soils.
- Soils contains arguably the most diverse terrestrial communities on the planet.
- It supports most life above ground by means of increasingly well-understood above and belowground linkages.

Aboveground and belowground biodiversity

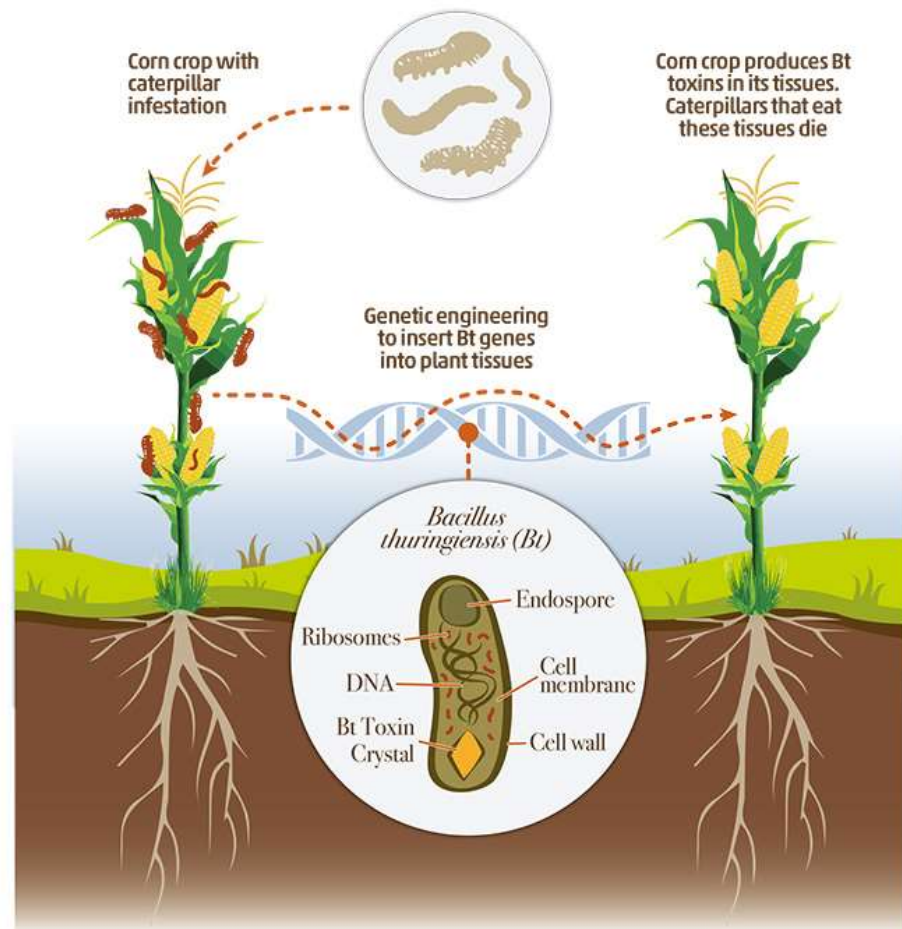


Why is soil biodiversity important?

Clean biotechnology in agricultural production

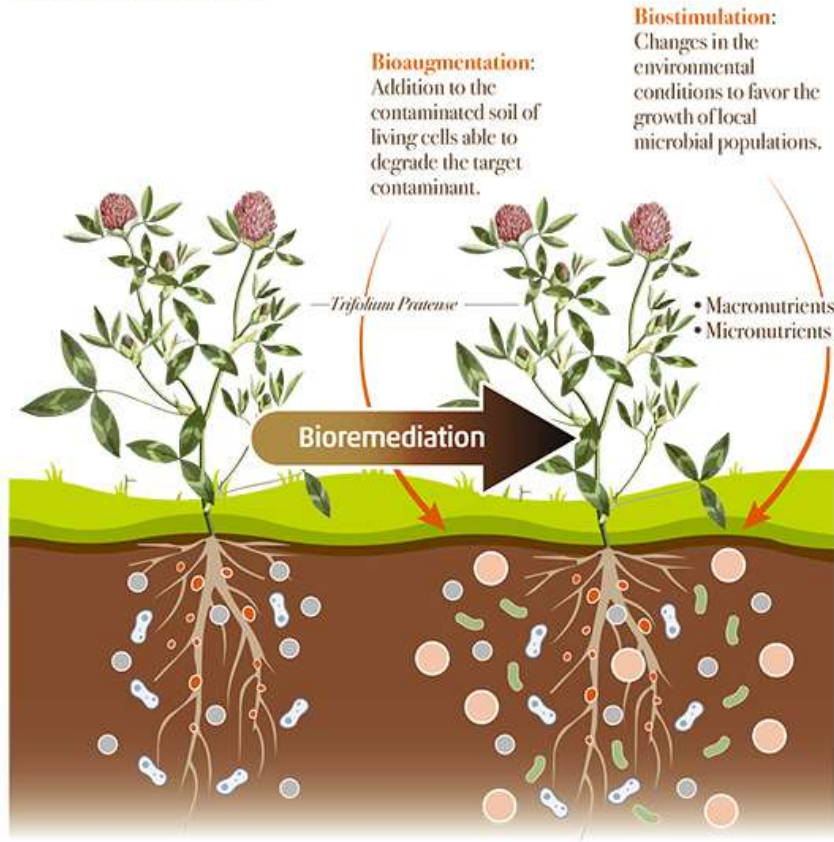


Biological control

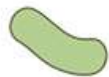


Why is soil biodiversity important?

Bioremediation



Indigenous bacteria



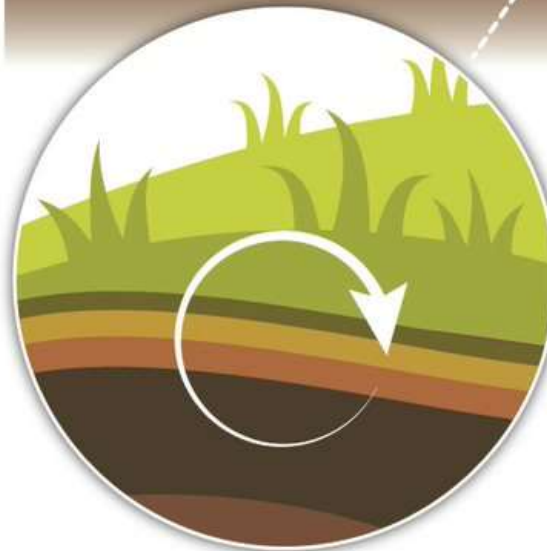
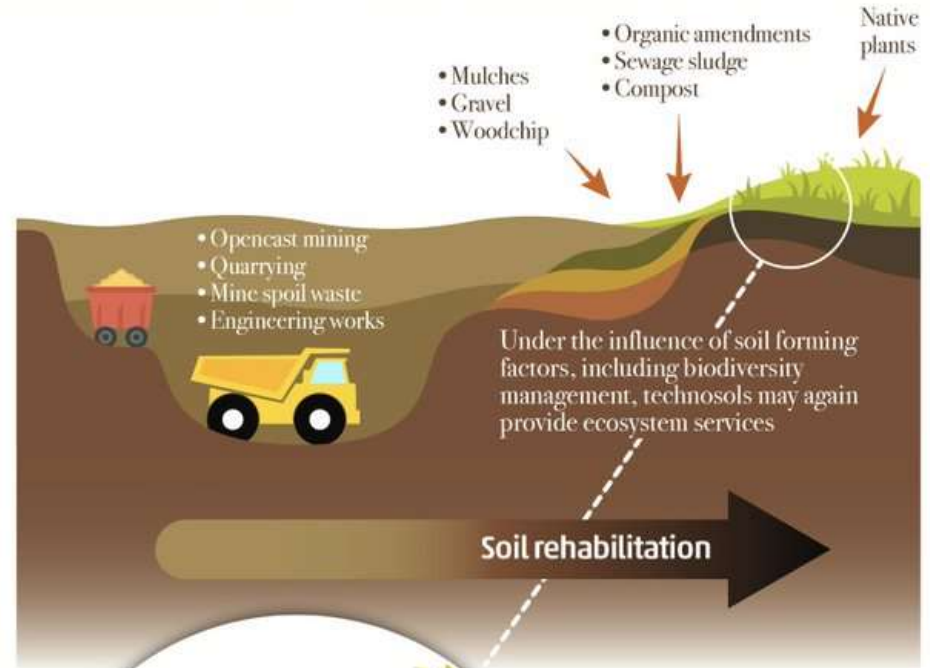
Exogenous bacteria



Contaminant agent



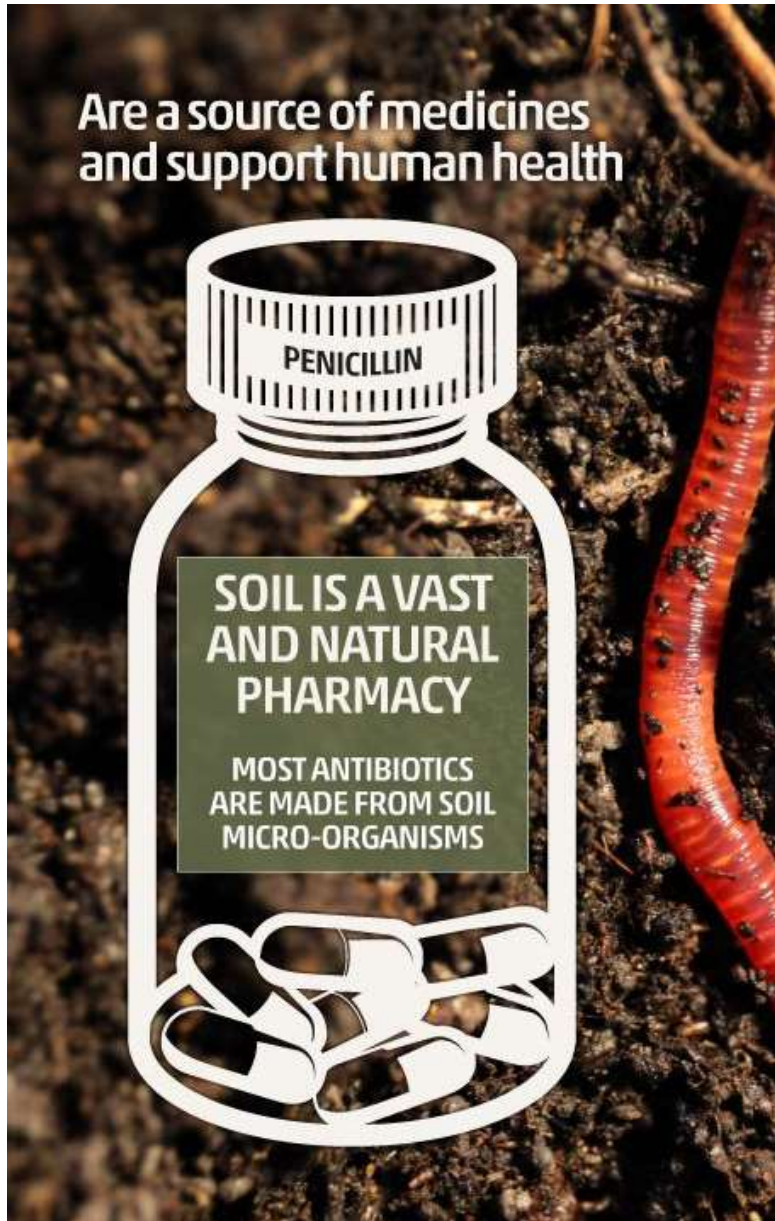
Various forms of limiting nutrients



Mulching + organic amendments

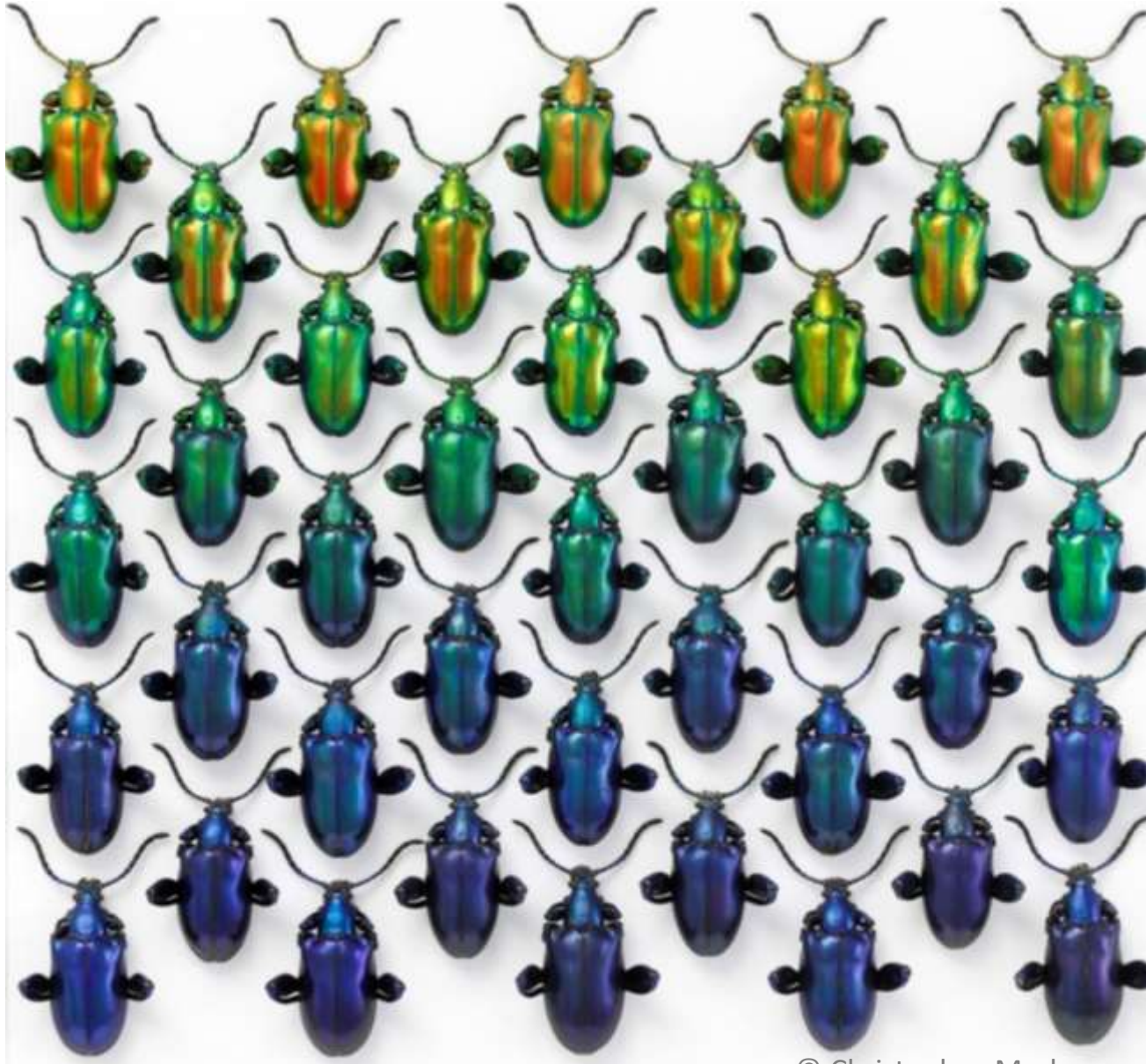
- Beneficial for restoring degraded soils
- Stimulate the growth and activity of soil fauna (i.e., microbes, nematodes, mites, springtails, earthworms, etc.).
- Increase soil fertility.

Why is soil biodiversity important?



- The discovery of antibiotics has had a major impact on increasing human life expectancy.
- The early exposure to a diverse collection of soil microorganisms might help prevent chronic inflammatory diseases, including allergy, asthma, autoimmune diseases, inflammatory bowel disease and depression.

Why is soil biodiversity important?



Beauty
inspires
art!!

YET SOIL BIODIVERSITY IS IN **GREAT DANGER** FROM

Unsustainable soil
management practices



MONOCULTURES LIMIT THE PRESENCE OF
BENEFICIAL BACTERIA, FUNGI AND
INSECTS, AND CONTRIBUTE TO ECOSYSTEM
DEGRADATION

Pollution

POLLUTION CAUSES A CASCADE OF SOIL
DEGRADATION PROCESSES AND AFFECTS
SOIL ORGANISMS BY REDUCING
BIOMASS AND SPECIES RICHNESS



Surface sealing and
urbanization

IN EUROPE,
11 HECTARES OF SOIL
ARE SEALED UNDER
EXPANDING CITIES
EVERY
HOUR



75bn t

Erosion

EACH YEAR, 75 BILLION
TONS OF SOILS AND THEIR
ORGANISMS ARE STRIPPED
FROM THE LAND BY WIND
AND WATER EROSION

SOIL BIODIVERSITY IS A NATURE BASED SOLUTION



COST OF INACTION:
50 BILLION €
PER YEAR AND COULD REACH
14 000 BILLION €
IN 2050



How is soil biodiversity threatened?



Deforestation drivers and effects on soils

- Land use change
- Loss of SOM and nutrients.
- Changes in soil physical properties.
- Disruption of suitable habitat.
- Changes in pH.



- Loss of specialist species and increase in generalist taxa.
- Decrease in predator species.
- Reduced soil and functional diversity.
- Recovery could take decades.



Agricultural intensification drivers and effects on soils

- Greater use of external inputs (pesticides, fertilizers) and more soil disturbance.
- Greater risk of soil erosion, contamination, land degradation, compaction and salinization.
- Alteration of hydrological and biogeochemical cycles.
- Disturbance of soil structure.
- Loss of SOM.



- Decrease in soil biodiversity.
- Smaller and less complex belowground food webs.
- Recovery of soil communities may take years or decades.
- Less efficient and functional soil food webs.
- Loss of soil carbon and nutrients through leaching.

Nutrient imbalances drivers and effects on soils

- Change in the availability of essential nutrients.
- Excessive use of mineral fertilizers.



- Reduces the growth capacity of soil microorganisms.
- Reduces nutrient flow through the soil food web.
- Alteration of the nutritional content of primary producers and litter inputs.



Acidification drivers and effects on soils

- Inadequate fertilization.
- Pollutants.
- Changes in plant community composition.
- Changes in solubility of multiple elements in soils.



- Alteration of the environment where soil organisms thrive.
- Hamper the activity of organisms involved in nitrogen cycling.
- Alteration of belowground food webs.
- Changes in nutrient availability and toxicity for microorganisms.



Salinization drivers and effects on soils

- Water absorption hampered by changes in chemical and physical soil properties.
- Irrigation with brackish water.
- Salt water intrusion due to aquifer exhaustion.
- Inadequate irrigation practices.



- Ion imbalance and nutrient deficiency decrease microbial functions and biomass.
- Shift in the composition of microbial, micro and mesofaunal communities.



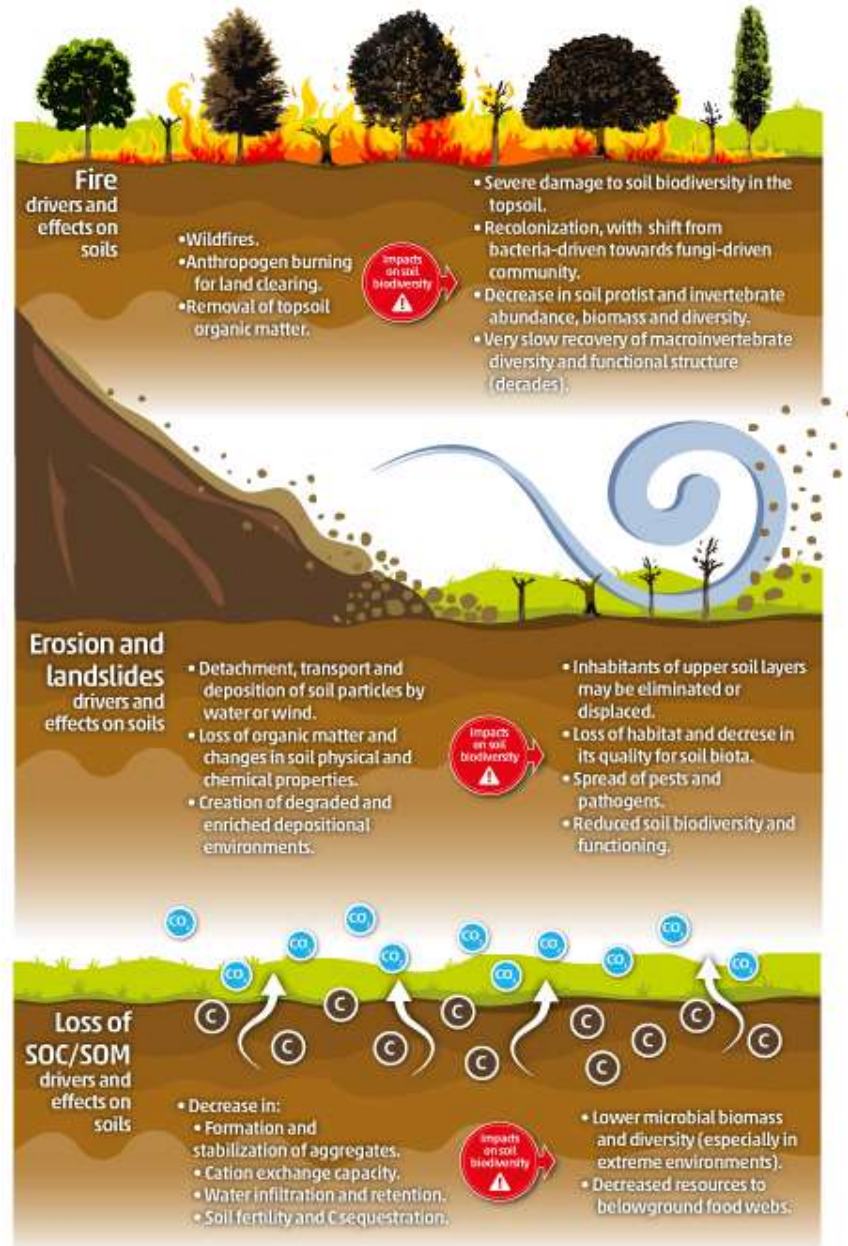
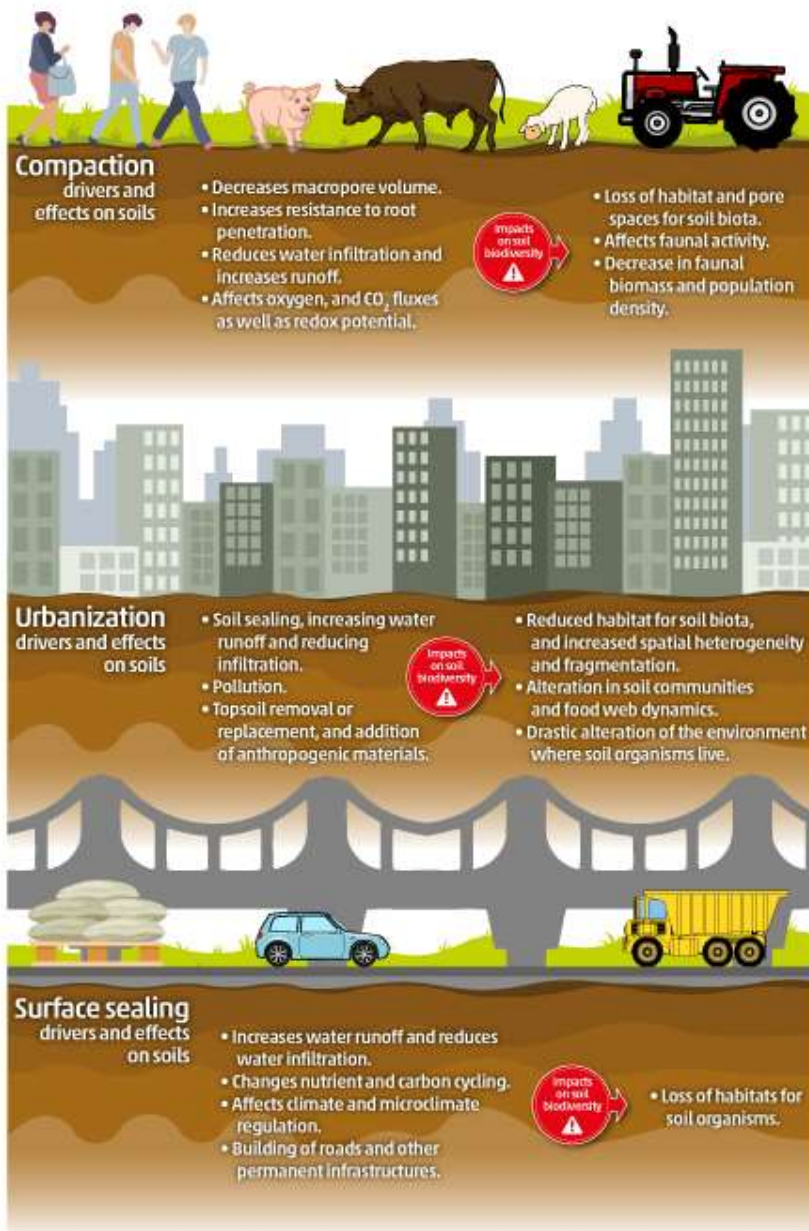
Pollution drivers and effects on soils

- Microplastics
- Fertilizer application.
- Persistent organic pollutants.
- Biocides and pesticides.
- Waste disposal.



- Acute and chronic toxicity to soil biota.
- Cascading effects from individual species to communities and ecosystem functions.
- Bioaccumulation in the food chain.

How is soil biodiversity threatened?

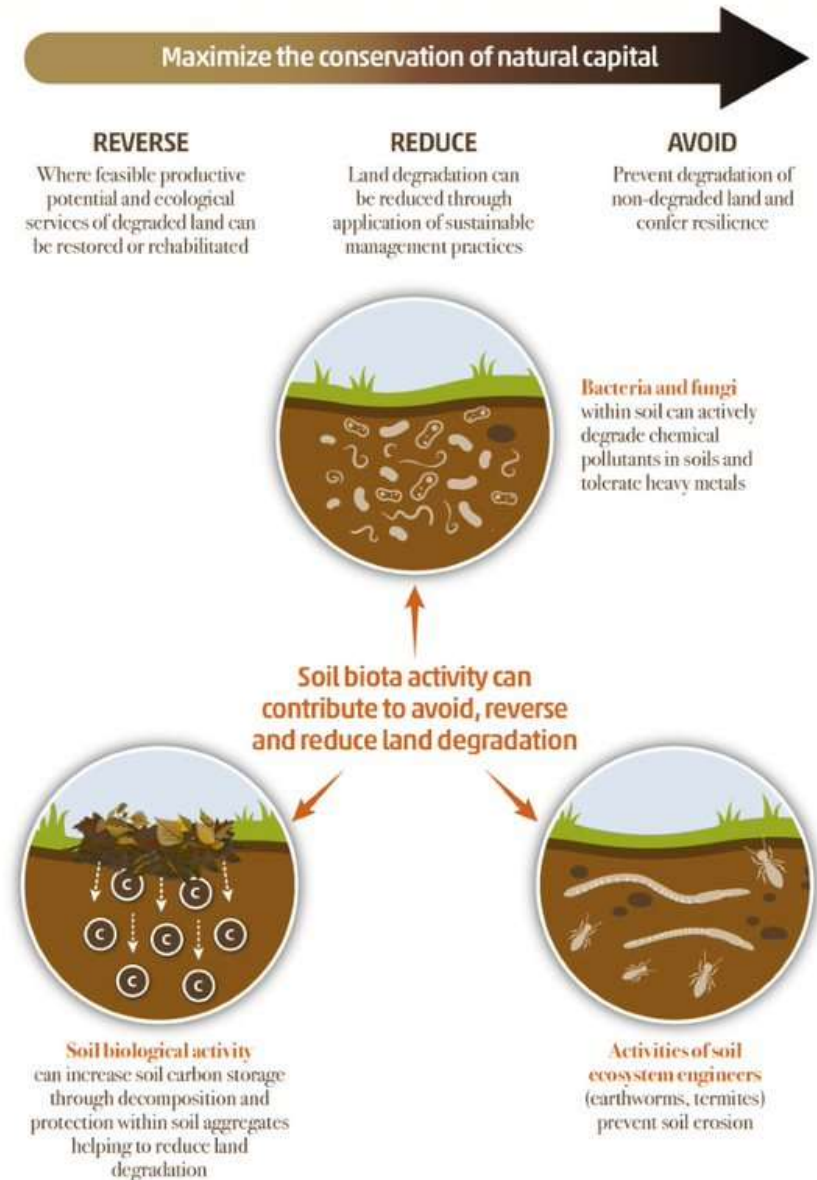


What are the challenges and gaps?



What are the potentialities?

- **Food security and food safety:** improvement of agricultural production (biofertilizers, nitrogen fixation, pathogen control).
- **Biological control:** pests, diseases.
- **Environmental remediation (bioremediation):** bioaugmentation, phytoremediation, vermiremediation.
- **Climate change mitigation/adaptation:** carbon sequestration, GHG.
- **Nature-based solutions:** stimulate the growth and activities of soil fauna for ecosystem restoration.
- **Nutrition and human health:** vaccines, medicines, traditional medicine, microbiome.



The way forward

1. **Advocate for mainstreaming Soil Biodiversity** into the sustainable development agenda, the **Post-2020 biodiversity framework**, the **UN decade on ecosystem restoration**, and all areas where SB can contribute;
2. **Develop standard protocols and procedures for assessing SB** at different scales;
3. Promote the **establishment of soil information and monitoring systems that include SB as a key indicator of soil health**;
4. **Improve knowledge** (including **local or traditional knowledge**) of the **soil microbiome**;
5. Strengthen the **knowledge on the different soil groups forming SB** (i.e., microbes, micro, meso, macro and megafauna);
6. Establish a global capacity building programme for the use and management of soil biodiversity and the **Global Soil Biodiversity Observatory**.
7. Execute the **Implementation Plan** of the International Initiative for sustainable management of Soil Biodiversity initiative.

WHAT CAN YOU DO?

REDUCE YOUR
FOOD WASTE BY
COMPOSTING

SUPPORT
AGRO-ECOLOGICAL
TOURISM

CLEAN-UP YOUR
NEIGHBOURHOOD

MINIMIZE
THE USE OF
FERTILIZERS IN
GARDENS/
FARMS

DISPOSE OF
YOUR GARBAGE
AND MASKS
RESPONSIBLY

TAKE PART IN
WORLD SOIL DAY
AND RAISE
AWARENESS

STIMULATE
INTEREST IN SOIL
BIODIVERSITY
AT SCHOOL

TAKE A
MAGNIFYING
GLASS AND ENJOY
THE SMALLER
THINGS IN LIFE

KEEP SOIL
ALIVE

World
Soil Day
2020

PROTECT SOIL
BIODIVERSITY



A stylized illustration of soil with various microorganisms and a small plant growing from it. The soil is depicted in shades of brown and grey, with numerous white line drawings of microorganisms like bacteria, fungi, and protozoa. A small green plant with a single leaf is growing from the top center of the soil.

**Thank you for
your attention**