



Lecture outline

- Soil fauna
- Abundance of soil organisms
- Soil food web
- Introduction to biochemical transformations

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Classification of soil animals

Animals (fauna), all heterotrophs

Macrofauna: Largely herbivores and detritivores (>2 mm in width)

Vertebrates	Gophers, mice, squirrels
Arthropods	Ants, beetles and their larvae, maggots, termites, grubs, spiders, millipedes, woodlice
Annelida	Earthworms
Mollusca	Snails, slugs

Largely predators

Vertebrates	Moles, snakes
Arthropods	Beetles, ants, centipedes

Mesofauna: Largely detritivores (0.2 - 2 mm in width)

Arthropods	Mites, collembola (springtails)
Annelida	Enchytraeid (pot) worms

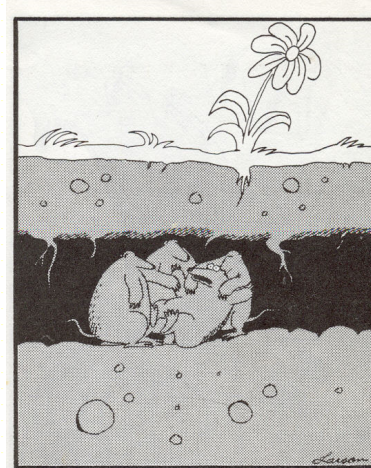
Largely predators

Arthropods	Mites, protura
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Microfauna: Detritivores, predators, fungivores, bacterivores (< 0.2 mm in width)

Nematoda	Nematodes
Rotiferia*	Rotifers, water bears
Protozoa*	Amoebae, ciliata

Vertebrates (mice, moles, ground squirrels, etc.) mix soil through their burrowing activity



"It's OK! It's OK! The tunnel was closing in on me there for a while, but I'm all right now."

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Photos: Wikimedia

Annelids (segmented worms) most important representatives are earthworms

<https://www.youtube.com/watch?v=n3wsUYg3XV0>



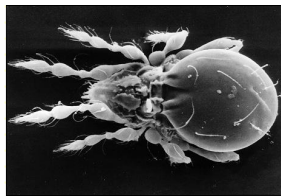
Arthropods (spiders, mites, springtails, insects) shred plant residues, mix it with soil, and stimulate decomposition within their intestines. Some are predators



Springtail (collembola)



Millipede



Arachnids mite



Spider

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earth

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Extreme Life | Tardigrade

Tardigrades return from the dead

Boil them, deep-freeze them, crush them, dry them out or blast them into space: tardigrades will survive it all and come back for more

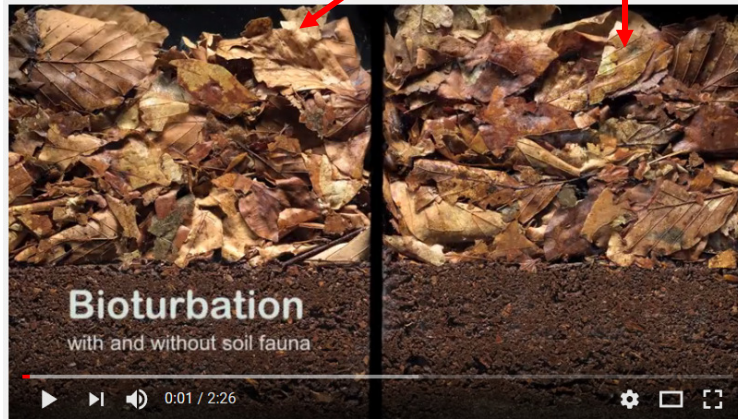
Functions:

- Predators of other animals and grazers of bacteria/fungi/algae → helps in nutrient cycling
- work as pioneer species by inhabiting new developing environments

<https://ed.ted.com/lessons/meet-the-tardigrade-the-toughest-animal-on-earth-thomas-boothby>

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Bioturbation (mixing) without & with soil fauna



<https://www.youtube.com/watch?v=Mxp1nnrUG0Q>

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Protozoa - “primitive animals”

- feed on fungi & bacteria (release excess NH_4^+ near root system), or fragments of organic matter
- help suppress disease by competing with or feeding on pathogens
- are food source for other soil organisms



Ciliate



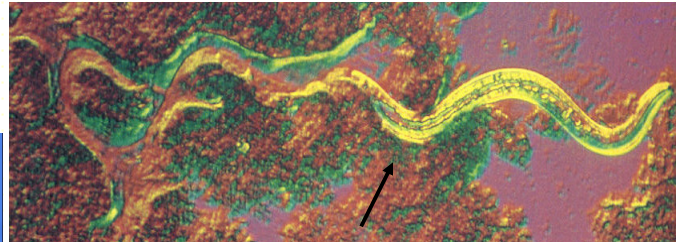
Flagellate

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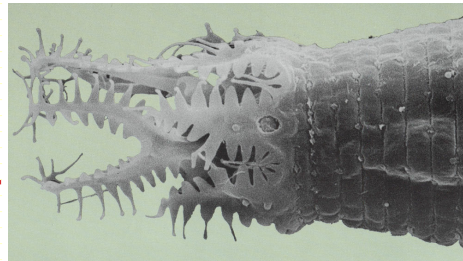
Nematodes (threadworms) - after consuming bacteria, nematodes excrete much of the excess N as inorganic N (ammonia), hence increasing mineralization



Mouth parts of a plant parasitic nematode

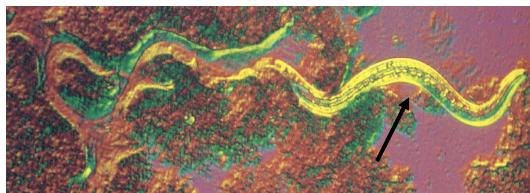


Mouth parts of a bacterial-feeding nematode



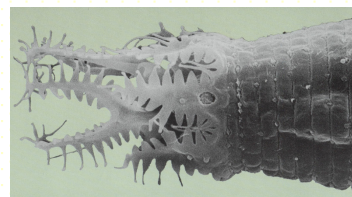
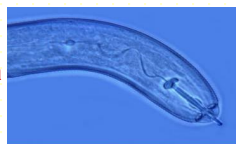
Nematodes (threadworms):

- bacterial-feeders - after consuming bacteria, nematodes excrete much of the excess N as inorganic N (ammonia) → increases nutrient cycling
- predators (used for biocontrol of insect pests)
- plant parasites (root feeders)



Mouth parts of a bacterial-feeding nematode

Mouth parts of a plant parasitic nematode





Numbers and biomass of soil organisms in the surface soils

Organism	Estimated number per g	Estimated biomass of species (kg/ha)
Bacteria	$10^8 - 10^9$	400-5000
Actinomycetes	$10^7 - 10^8$	400-5000
Fungi	$10^5 - 10^6$	1,000-15,000
Algae	$10^4 - 10^5$	10-500
Protozoa	$10^4 - 10^5$	20-200
Nematodes	$10 - 10^2$	10-150
Mites	1-10	5-150
Collembola	1-10	5-150
Earthworms	$10 - 10^3$ per m ²	3,000 (in BC)

Estimated number of species in BC

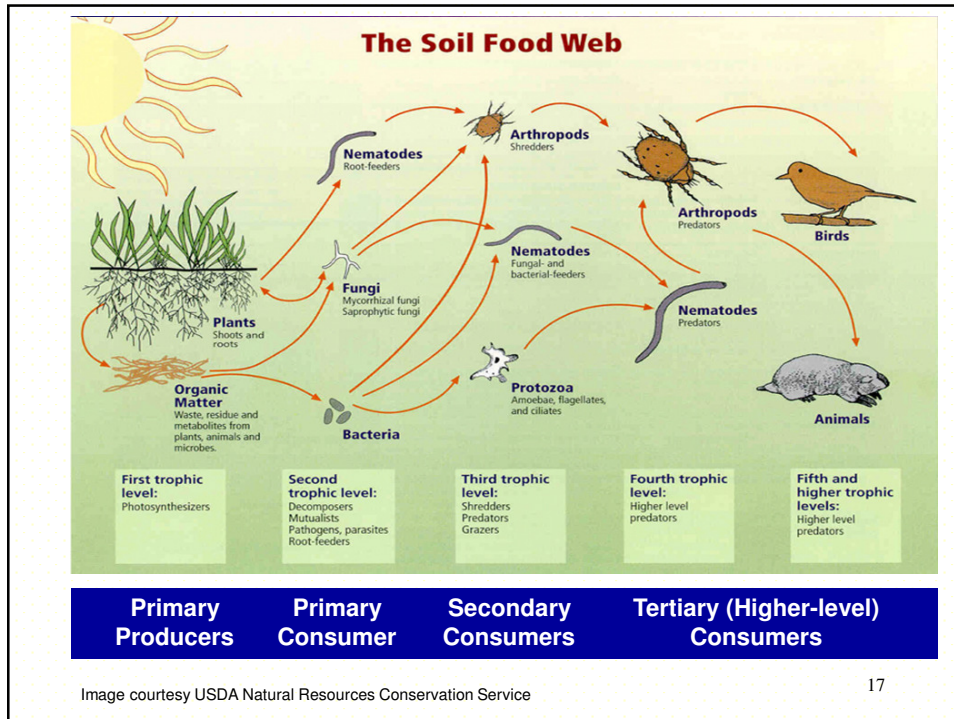
- **Vascular plants** 2,500 species
- **Birds** 450 species
- **Mammals** 100 species
- **Reptiles** 20 species
- **Amphibians** 20 species

Most species in the groups listed above have been identified

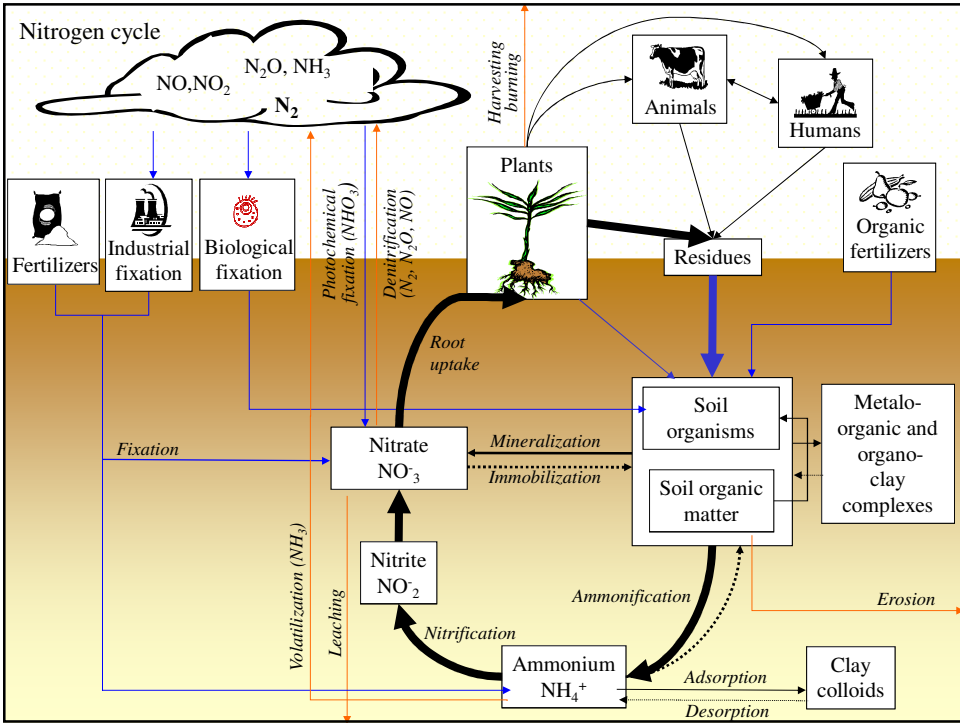
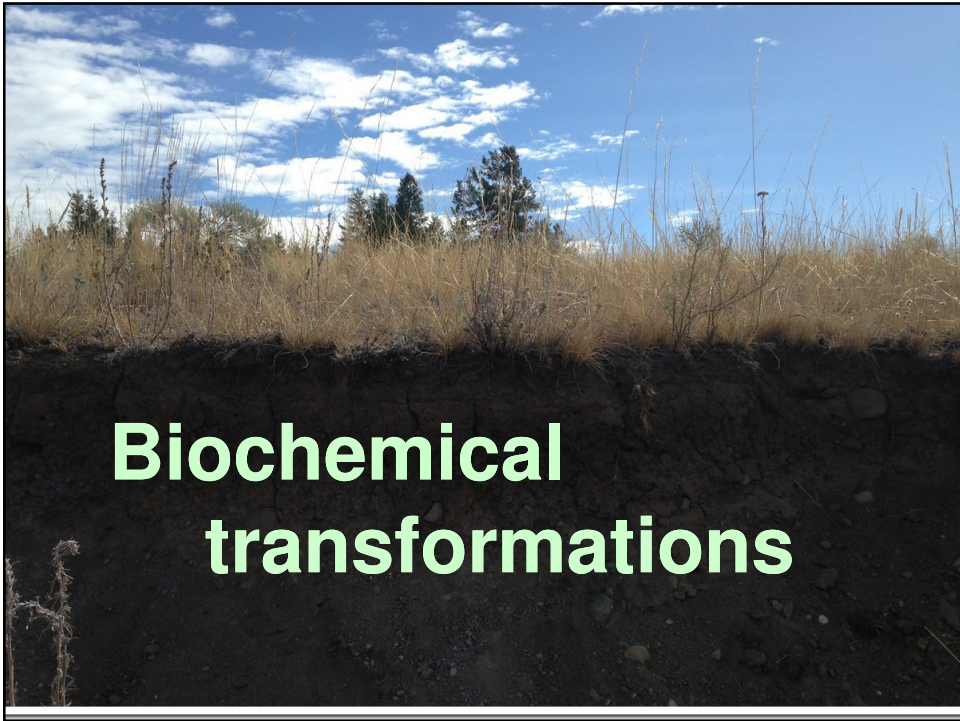
- **Arthropods** 35,000 species (~50% are not yet identified)

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What are the reasons for greater biological diversity in soils relative to aboveground ecosystems?



The sources of soil N are:


- Biological fixation of N_2 
 - Deposition of N (NO_3^- and NH_4^+) compounds from the atmosphere by precipitation
 - Fertilizers
 - Plant residues 
 - Manure 
-  Addition of organic matter



Processes that are mediated by soil organisms

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The losses of soil N occur through:

- Plant removal
- Leaching
- Gaseous losses (denitrification  and NH_3 volatilization)
- Erosion (wind and water)
- Ammonium fixation (clay complexes)



Processes that are mediated by soil organisms

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