



# **The Factory of Life**

### **European Land and Soil Alliance meeting, 07 May 2010**

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(The opinions expressed are personal to the author)





# Surprising facts



A crowded place: Soils are home to over one fourth of all living species on Earth



# Surprising facts



**An active world**: Very sophisticated strategies of communication, symbiosis and predation

A dormant world: Many of the soil dwellers can undergo cryptobiosis – a dormant state



# Surprising facts



**An aquatic environment**: All organisms live in the pores of the soil; many are purely aquatic organisms that live in the water contained in those soil pores







# An amazing variety of life: There is more than meets the eye!







#### Bacteria

From 0.5 to 5  $\mu m$  - live in water-filled pore spaces

They grow and divide extremely rapidly but 90% bacteria in soil are inactive

Soil bacteria can uptake proteins and DNA directly from the soil



### Fungi

One gram of soil can contain as much as 1 million individual fungi; fungi biomass in temperate soil is 2-5 t/ha

Reproduce via both sexual and asexual reproduction

Live for many years

# **Protists**

10–50  $\mu m$  - live in water-filled pore spaces

Asexual reproduction

They have also dormant stages







#### **Nematodes**

0.5-1 mm in length – live in water films; 500,000 speciesMost nematodes have sexual reproductionHave the capacity to become dormant

#### **Microarthropods**

0.2-6 mm - live in surface litter - 50,000 mite species known - estimated up to 1 million

Mostly reproduce sexually

Life-span of about 6 months

# **Termites**

0.5-2 cm- live in the pores – few species in EuropeEusocial insects living in organised coloniesLive few weeks - royal couple can live for years









#### Ants

0.75 to 52 mm in pores of soil in nests – few species in EUEusocial animals living in organised coloniesLive few months to several years

#### Isopods

Crustaceans from 0.5 mm to tens of cm- some live in the water pores some in the litter

Sexual reproduction

About 2 years

#### Worms

Few millimetres to tens of centimetres – live in the space that they have just emptied by soil ingestion

Earthworms are hermaphrodites – only 20-30% make it to adulthood

Live one to several years





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#### **Plant roots**

#### 2mm

root hairs live only a couple of days, other parts a couple of days or weeks, larger anchoring roots can become as old as the plant itself.

#### Moles

15 cm- live in extensive system of permanent and semipermanent tunnels – in all Europe except Ireland

Males -females are solitary--males tunnel over large areas searching for females -

Usually not beyond 3 years



#### **Badgers**

At least 30 cm- partly in the soil partly out

# How to classify them?



# **Three Functional Groups**



**Microbial decomposers** (transformers and decomposers): responsible for carbon transformation through the decomposition of plant residues and other organic matter, and for the transformation of nutrients (e.g. nitrogen, phosphorus, sulphur)



**Biological regulators:** responsible for the regulation of populations of other soil organisms, through grazing, predation or parasitism, including soil- borne pests and diseases.



**Ecosystem engineers:** responsible for maintaining the structure of soil by the formation of pore networks and bio-structures, and aggregation, or particle transport.



# The 6 main ECOSYSTEM SERVICES PROVIDED by soil biodiversity :

Soil organic matter and nutrient recycling and fertility, including soil formation: a basic function that supports nutrient cycling (C, N and P cycles) and primary production

**Regulation of carbon flux and climate control** via the carbon storage

Water cycle regulation, infiltration, storage, purification, transfer to aquifers and surface effluents, erosion prevention and regulation of flows in effluents (flooding or drying out of rivers)

Decontamination and bioremediation: a chemical and physical neutralisation of contaminants

Pest control: biological control of pests and pathogens of plants, animals and humans.

# Human health- pharmaceutical applications



# The 6 main ECOSYSTEM SERVICES PROVIDED by soil biodiversity :

# **Soil organic matter and nutrient recycling and fertility**



#### Soil organisms are cooking their own meal and that of others



### The 6 main ECOSYSTEM SERVICES PROVIDED by soil biodiversity :

Regulation of carbon flux and climate control via the carbon storage





# The 6 main ECOSYSTEM SERVICES PROVIDED by soil biodiversity

**Water cycle regulation** 





### The 6 main ECOSYSTEM SERVICES PROVIDED by soil biodiversity :

### Pest control



Black cherry in the USA: density control by soil pathogens

Black cherry in the Europe: no soil pathogens → invasive spread



### The 6 main ECOSYSTEM SERVICES PROVIDED by soil biodiversity :

# Human health pharmaceuticals (eg peniciline, rapamycine)





# HOW MUCH WE EARN FROM THEM?



Total estimated economic benefits of ecosystem services provided by soil biodiversity worldwide

Service	World economic benefits of biodiversity
	(x US\$10°/year)
Waste recycling	760
Soil formation	25
Nitrogen transformations	90
Chemical detoxification	121
Biotechnology	6
Wild food	180
<b>Biocontrol of pests</b>	257
Pollinators	200
Total	1,542

# WHAT INFLUENCES THEM?



# **BIOTIC FACTORS**

- competition,
- predation,
- grazing,
- mutualism
- symbiosis
- infectivity

# **ABIOTIC FACTORS**

- climate (temperature, moisture)
- pH
- salinity
- soil structure
- soil texture

WHAT ARE THEIR PROBLEMS?



# SOIL DEGRADATION PROCESSES



- CLIMATE CHANGE
- SOME LAND USES + INADEQUATE LAND MANAGEMENT
- INVASIVE SPECIES

**A STUDY PROVIDING MUCH MORE INFORMATION** 



# Report Soil biodiversity: functions, threats and tools for policy makers

http://ec.europa.eu/environment/soil/biodiversity.htm

To be discussed at **Green Week** on 2 June 2010 and officially presented at the high-level conference **Soil, Climate Change and Biodiversity: Where do we stand?** in Brussels on 23-24 September 2010

### The CAP after 2013 – Your ideas matter



Internet consultation at http://ec.europa.eu/agriculture/cap-post-2013/debate/index\_en.htm

The Common Agricultural Policy is due to be reformed by 2013. A formal public consultation on the CAP post-2013 will be undertaken later this year when the Commission will publish a policy paper setting out different options for the future CAP.

'The Common Agricultural Policy is for all of society. It is your policy, not just for farmers. European agriculture is about food security, but also about landscapes, employment, <u>environment</u>, climate change. Let us know what your needs and expectations are for the future of agriculture and rural areas in Europe. Help us put forward a policy that serves them best!'

The Commissioner invites all interested EU citizens and organisations - whether or not they work in the area of agriculture - to join the debate on the future of the Common Agricultural Policy, its principles and objectives.

The CAP is more than just a policy for farmers: There is a clear link between agriculture, the environment, biodiversity, climate change and the sustainable management of our natural resources such as water and <u>land</u>.

An opportunity for bringing more soil protection to Europe !