



A JOURNEY INTO THE FIRST EVER GLOBAL SOIL BIODIVERSITY ATLAS



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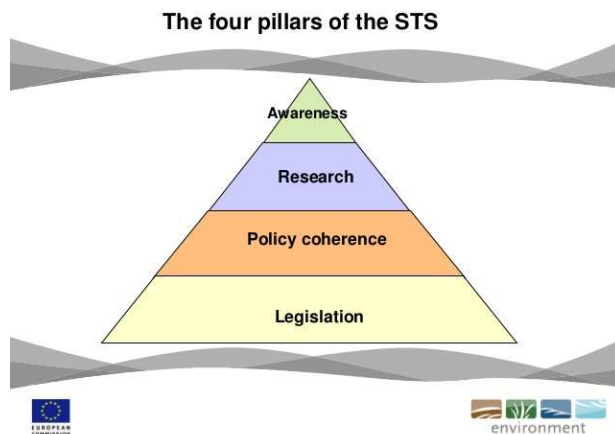
Launch of the Global Soil Biodiversity Atlas in France,
28th November 2016



DRIVERS

European Union perspective

- EU Biodiversity Strategy to 2020
- EU Soil Thematic Strategy (STS)
 - Awareness raising is core concept



GLOBAL SOIL BIODIVERSITY INITIATIVE



GLOBAL SOIL PARTNERSHIP

- JRC science service of the European Commission – provide EU policies with scientific base

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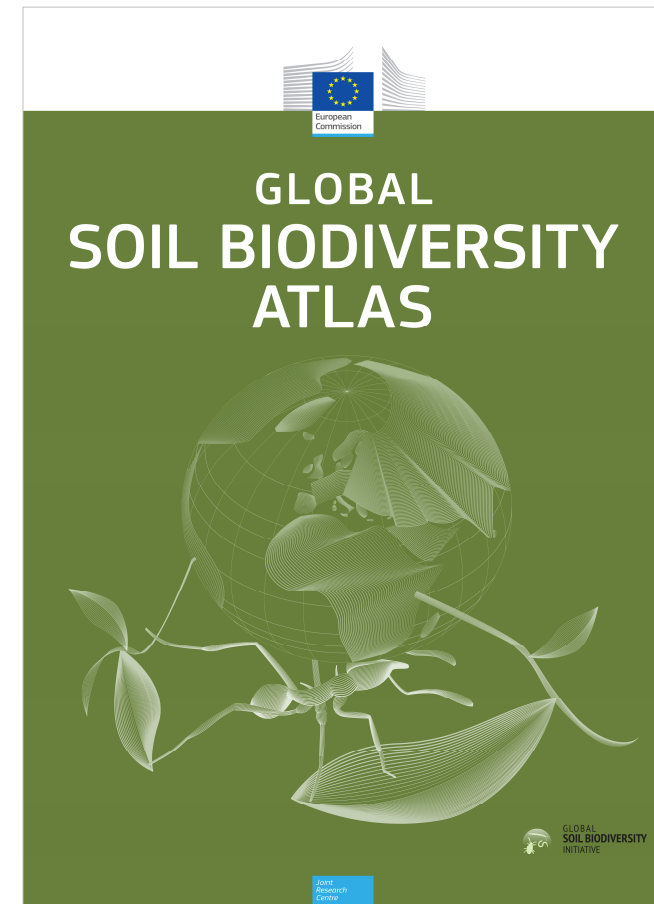


DEPARTURE – February 2013
1st workshop to plan the
GLOBAL SOIL BIODIVERSITY ATLAS
Colorado State University – Fort Collins CO, USA

- Editorial board
- 27 soil biodiversity scientists from 5 continents
- Contributors
- 90 experts from all over the world
- 8 chapters

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CHAPTER 1

THE SOIL HABITAT

- What is soil?
- Where does soil come from?
- Soil-forming factors
- Soil-forming processes
- Map of global distribution of soils



CHAPTER 1

THE SOIL HABITAT

Map of global distribution of soils

Climate plays an important role in soil formation. Hence, soils generally differ from one major climatic zone to another. Equatorial regions, with high temperature and rainfall levels, have deep, strongly weathered and very leached soils with low nutrient levels. More and more conditions, with low precipitation and high evaporation, produce soils containing easily soluble components such as calcium carbonate or gypsum. Soils in temperate climates tend to have more organic matter while the effects of parent material and precipitation levels are more evident. In cold climates, soil formation is restricted and strongly influenced by freeze-thaw processes, and the presence of ice in the subsoil (permafrost). Frost climates also play an important role in determining current soil distribution, especially in the subarctic and northern temperate regions where glaciers have removed all soil material and new soils were formed after the retreat of the ice. Consequently, soils of these regions are relatively young or 'immature'.

Soil classification schemes generally reflect different concepts of soil formation. The boxes on these two pages are simplified descriptions of the world's major soil types according to the World Reference Base for Soil Resources (WRB), an internationally used soil classification system. More information on the WRB system can be found at: www.fao.org/soils/portal/wrb-survey/wrb-soils/wrb-soils-reference-base/wrb-soils

Acrisols: from Latin *acer*, acid
Strongly acid soils with a clay-enriched subsoil and low nutrient holding capacity. Mainly found in the wetter parts of the tropics and subtropics. Normally associated with acidic bedrock and deficient in nutrients. They require substantial applications of fertilizer to produce satisfactory crop yields. (C5)

Albeluvisols: from Latin *alb*, white, and *luvis*, to wash out
Soils with a subsurface horizon that tongues into a horizon which has accumulated clay, formed mostly in unconsolidated deposits on flat to undulating plains under coniferous or mixed forest in boreal and temperate climates with cold winters and short cool summers. (B4)

Alisols: from Latin *alio*, elsewhere, elsewhere
Very acid soils with a clay-enriched subsoil and high nutrient holding capacity. Acidity is caused by the weathering of minerals which release a large amount of aluminum – often at levels that are toxic to most crops. They occur in humid tropical, humid subtropical and warm temperate regions. (B3C)

Andosols: from Japanese *an*, black, and *do*, soil
Soils developed from materials ejected from volcanoes (e.g. ash, tephra and cinder) which weather to produce specific clay minerals. In humid climates, many Andosols develop a thick, dark topsoil as a result of the fixing of organic substances by aluminum that is released from the weathering of the clay minerals. (B3C)

Anthrosols: from Greek *anthropos*, man
Soils that exhibit surface horizons that have been modified profoundly through human activities, such as addition of organic materials or household wastes, irrigation and cultivation. These include paddy, paddy and oasis soils as well as the *terra preta* (black earth) in Brazil. However, they are not evident due to the scale of the accompanying map. (C2)

Arenosols: from Latin *aren*, sand
Developed as a result of in situ weathering of quartz-rich parent material or in recently deposited sands (e.g. dunes in deserts and beaches). Among the most extensive soil types in the world. Soil formation is often limited by slow weathering rates due to wind erosion. (B3C)

Calcisols: from Latin *calcarius*, lime-rich
Formed through the leaching of carbonates from the upper part of the soil which precipitate when the subsoil becomes oversaturated or by the evaporation of water which leaves behind dissolved carbonates. Found in dry climates. (B4)

Cambisols: from Latin *cambere*, to change
Young soils, generally lacking distinct horizons or with only slight evidence of soil-forming processes usually through variations in colour. The formation of structure or presence of clay minerals. Globally extensive – characteristics depend on the nature of the parent material. (B3C)

Chernozems: from Russian *chern*, black, and *zemle*, earth
Soils with a very dark brown or blackish surface horizon with a significant accumulation of organic matter and a neutral pH. Secondary calcium carbonate deposits occur within 50 cm of the lower limit of the humus-rich horizon, high biological activity. Typically found in grasslands in temperate climates. (B4)

Cryosols: from Greek *kryos*, cold or ice
Soils from cold regions where permafrost is found. Water occurs primarily in the form of ice and cryogenic processes, such as freeze-thaw cycles, cryoturbation, frost heave and cracking, are the dominant soil-forming processes, often giving distinct horizons and patterned ground. (B3)

Durisols: from Latin *durus*, hard
Associated with old surfaces in arid and semi-arid environments. They display hardened accumulations of silica (SiO₂) in the soil. Durisols develop over long periods during which the soil reaction is to alkaline (pH > 8) that the siliceous elements inside. Regarded as 'fossil' soils. (E1)

Gleysols: from Russian *gley*, muddy mass
Occurring in low-lying areas of overexposed where groundwater comes close to the surface and the soil is saturated for long periods of time. Other than characteristic colours depending on whether oxygen is present, they display little soil development. Often found with wetland vegetation. (C3)

Ferralsols: from Latin *ferreus*, iron, and *sol*, element, soil
Mostly associated with high rainfall areas and very old land surfaces, they are strongly leached soils that have lost nearly all of their weatherable minerals over time. Dominated by stable products, such as aluminum oxides, which give strong red and yellow colours. Nutrient poor. (C2)

Fluvisols: from Latin *fluvi*, river
Occurring in all periodically flooded areas, such as flood plains, river fans, valleys, tidal marshes, and mangroves. Fluvisols show a layering of sediments with pedogenic horizons as a result of deposition by water. Their characteristics depend on the nature and sequence of the sediments. (D1)

Kastanzems: from Latin *castaneus*, chestnut, and Russian *zemle*, earth
Soils with a deep, dark coloured surface layer with a significant accumulation of organic matter, high base cationation and a well-developed structure. The subsoil is high, which enforces strong leaching of clay particles and the formation of the nut-shaped aggregates with shiny surfaces. (C5)

Lixivisols: from Latin *lixiv*, washed-out substances
Slightly acid soils that show a distinct increase in clay content with depth. Broadly distributed worldwide with limited capacity to hold nutrients. Found in the dry seasonally regions, with low biomass production, they have low organic matter content and lack a well-developed soil structure. Prone to erosion. (B4)

Luvosols: from Latin *luvis*, to wash
Soils with a distinct increase in clay content with depth as a result of clay movement from the upper part of the soil to the lower part. The clay gives a high nutrient-holding capacity. In general, Luvosols have a well-developed soil structure, which contributes to a good water-holding capacity. (B3C)

Mistosols: from Greek *mistos*, mixture
Also known as peat, Mistosols contain a high amount of organic matter in clay movement from the upper part of the soil to the lower part. The clay gives a high nutrient-holding capacity. In general, Mistosols have a well-developed soil structure, which contributes to a good water-holding capacity. (B3C)

Podzols: from Russian *pod*, under, and *zola*, ash
Soils with a distinctive ash-grey horizon which has been leached by the loss of organic matter, and iron oxides. They sit on top of a dark accumulation horizon of redistributed humus and/or reddish iron compounds. Typically occurring in humid temperate climates in coarse sand deposits. (B4)

Regosols: from Greek *regos*, blanket
Soils in unconsolidated medium and fine-textured material showing only slight signs of soil development and some accumulation of organic matter producing a somewhat darker horizon. Similar to Arenosols (sand) or Luvisols (gravel). Soil development limited by low temperatures or acidity. (C5)

Solonchaks: from Russian *solon*, salt, and *chak*, strongly expressed
Strongly saline soils with a dense, columnar clay-rich subsoil containing a high amount of exchangeable cations, which has the ability to disperse clay particles and organic matter from the topsoil. Found in other parts of the world. Found in flat lands in climates with hot, dry summers or former salty coastal deposits. (B4)

Stagnosols: from Latin *stagnare*, to flood
Soils with a pre-set water table, often caused by the presence of an impermeable barrier deep in the soil, leading to temporary water logging and the mobilization of iron and/or manganese. This process gives rise to a characteristic colour pattern. Commonly referred to as *podsol* (B5) – not visible due to the scale of the map.

Technosols: from Greek *technos*, artificially made
Soils containing man-made artefacts (e.g. household or industrial waste material that has been brought to the surface (e.g. mine dumps, oil spills) or soils created by an artificial surface (e.g. roads, hard-standing areas). Often contain toxic material. (C5) – not visible due to the scale of the map.

Umbisols: from Latin *umbra*, shade
Soils with a deep, dark coloured surface layer that is rich in organic matter but has a low nutrient content. They are mainly associated with acid parent materials and areas with high rainfall. Umbisols are the counterpart of nutrient-rich soils with a dark surface horizon (e.g. Chernozems and Phaeozems). (B4)

Vertisols: from Latin *vertere*, to turn
Clayey soils that exhibit cracks which open and close upon drying and wetting due to the presence of the clay mineral, montmorillonite. This process brings material from the surface into the subsoil, giving rise to a 'churned' soil. Typically found in lowland areas that are periodically wet. (E1)

Gypsisols: from Greek *gypsis*, gypsum
Similar to Calcisols, these are soils with secondary accumulations of gypsum (CaSO₄·2H₂O). They are found in the driest parts of the arid and semiarid zone and often reflect former lake beds that have dried up through evaporation. Vegetation is sparse (spergularia, vitex and grasses). (D2)

Histosols: from Greek *histos*, tissue
Soils with a distinct increase in clay content with depth as a result of clay movement from the upper part of the soil to the lower part. The clay gives a high nutrient-holding capacity. In general, Histosols have a well-developed soil structure, which contributes to a good water-holding capacity. (B3C)

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CHAPTER 2

DIVERSITY OF SOIL ORGANISMS

- Prokaryota
- Protists
- Fungi
- Photosynthesisers
- Microfauna
- Mesofauna
- Macrofauna
- Megafauna
- Methods to study soil biodiversity



CHAPTER 2

DIVERSITY OF SOIL ORGANISMS

Clear texts

Comprehensive illustrations

Effective images

Informative boxes

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Photosynthesisers – Plants

Morphology

Plants are organisms that have a visible part aboveground (the shoot system) and a hidden part belowground (the root system). The extreme variety in the shapes of the visible portion of the plants is also present in the roots below the surface of the soil. The two main types of root systems are fibrous and taproot. Fibrous roots are the traditional structures formed by primary and secondary roots branching in all directions in the soil. By contrast, taproots are characterised by a single firm root growing straight down, with minor roots developing either side of it. Other specialised roots do exist: for example, the tubercous roots of sweet potato are modified for the storage of nutrients and water, while the stilt roots of mangroves allow the plant to be stable in wet and muddy soils by cropping up from the trunk and growing downwards. Roots are usually covered by root hairs that are invisible to the naked eye and form a large surface area allowing plants to take up water and mineral nutrients from the soil [40, 41]



Taxonomy

Green plants (Viridiplantae), are a kingdom of organisms including from 300 000 to 315 000 different species. The majority, 260 000 to 290 000 species, produce seeds. The two main groups of seed plants are the flowering plants (Angiosperms) and the naked-seed plants (Gymnosperms). Angiosperms produce fruits containing seeds and include the most common vegetables and fruits used as food by humans. Angiosperms comprise

fibrous root systems, and dicotyledons (e.g. carrots and apples) that have taproot systems. Gymnosperms include the conifers, which are woody plants with cones and root structures similar to those of dicotyledons.

Microhabitat

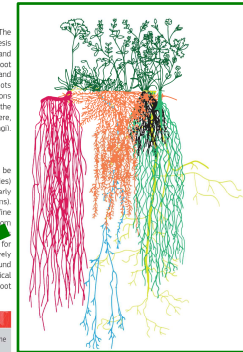
Plants are found everywhere, from tundra to desert. The aboveground parts of plants are responsible for the photosynthesis (see box on page 35) that provides energy for the plants and replenishes oxygen in the atmosphere. By contrast, the root system has three main functions: 1) absorption of nutrients and water; 2) anchorage to soil; 3) storage of nutrients. Plant roots generally grow anywhere with suitable environmental conditions and readily explore soil macropores (see page 72). The part of the soil that is directly influenced by roots is called the rhizosphere, and is very rich in soil microorganisms (e.g. bacteria and fungi).

Diversity, abundance and biomass

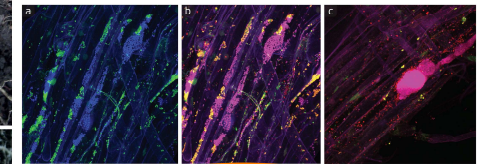
The number of known plant species has been estimated to be around 400 000. The majority (i.e. 260 000–290 000 species) belong to seed plants with around 1 000 Gymnosperms. Nearly all the others are classified as flowering plants (Angiosperms). It is difficult to estimate plant root biomass because: 1) the fine roots are difficult to sample and 2) the separation of living from dead roots is very tedious. Nevertheless, as a general rule, we allocate relatively more biomass to roots if the plant is poor at growth in belowground (e.g. wheat), while a plant that is relatively more biomass to shoots if the plant is poor at growth in aboveground (e.g. light). For this reason, root biomass is usually typical of plants living in woodlands, while a higher root biomass can be found in desert plants.

Amazing numbers of plant roots

- The maximum rooting depth, 68 metres, was found in a plant in the Kalbarri Desert.
- A single winter rye plant (*Secale cereale*) can grow roots measuring 620 kilometres in only 0.5 cubic metres of soil.
- A grove of over 4000 coastal quaking aspens (*Populus tremuloides*), located in south-central Utah (USA), has the largest root system in the world. It is estimated to weigh 6500 tonnes.



Plant roots can have different traits. Architectural traits determine the spatial configuration of the entire root system and include rooting depth, root length density and root volume. The way roots grow in the soil affects the way they interact with soil microorganisms and soil bioturbators, such as associations with mycorrhizal fungi and rhizobia (see pages 55–56, but also interactions with pathogens (see box on page 58) (adapted from Bandaghi et al., Trends in Ecology & Evolution, 2015, 30:101–112).



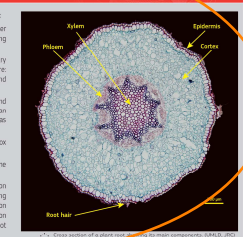
Micrographs of the rhizosphere. The three images show the rhizosphere of a plant root. (a) shows a root with a dense layer of bacteria. (b) shows a root with a dense layer of bacteria. (c) shows a root with a dense layer of bacteria. Different microbes do not share habitats, but rather colonise different areas of the rhizosphere, according to each other. (40)

Root structure

Observing a cross section of a plant root, the main visible structures are:

- root hair: they have fundamental importance in absorbing water and nutrients and in attaching the plant to the soil or other growing surface. They are lateral extensions of a single cell.
- epidermis: a single-layer group of cells that forms a boundary between the plant and the external environment. Its functions are protection against water loss, regulation of gas exchanges, and absorption of water and mineral nutrients;
- cortex: formed by unspecialised cells lying between the epidermis and the vascular or conducting tissues (xylem and phloem). These cells can be colonised by symbiotic fungi (see page 40). In some plants, such as carrots, the cortex becomes a storage organ.
- phloem: conducts products of photosynthesis (i.e. sugars – see box on page 35) from leaves to roots;
- xylem: conducts water and minerals from the roots up through the plant.

Typical roots contain meristematic, elongation, and differentiation zones. In the meristematic zone, cells undergo rapid division, creating new cells for root growth. These cells begin to elongate (elongation zone), giving the root added length. The zone of differentiation contains mature, specialised cells, such as phloem, xylem, and root hairs.



CHAPTER 3

GEOGRAPHICAL AND TEMPORAL DISTRIBUTION

- Distribution patterns
- Soil biodiversity and time
- Soil biodiversity and ecoregions
- Anthropogenic ecosystems
- Map of global distribution of soil biodiversity

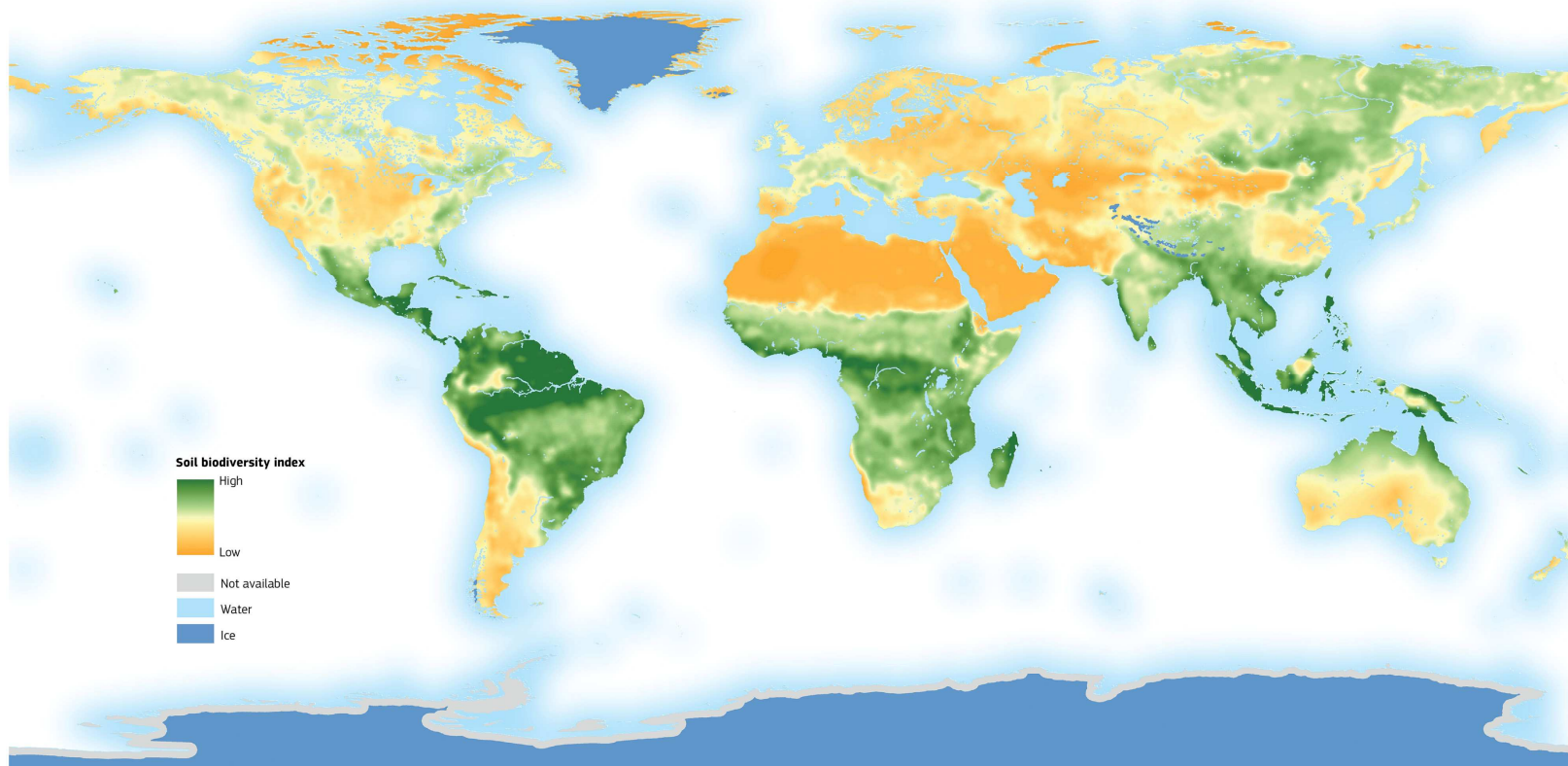


CHAPTER 3

GEOGRAPHICAL AND TEMPORAL DISTRIBUTION



Map of global distribution of soil biodiversity



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CHAPTER 4

ECOSYSTEM FUNCTIONS AND SERVICES

- Provisioning services
- Regulating services
- Supporting services
- Cultural services



CHAPTER 4

ECOSYSTEM FUNCTIONS AND SERVICES

- Production of food and fibre
- Biotechnology
- Atmospheric composition and climate regulation
- Water supply and quality
- Biological population control
- Soil formation and maintenance
- Natural capital

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Supporting services – Soil formation and maintenance



CHAPTER 5

THREATS

- Loss of aboveground biodiversity
- Introduction of invasive species
- Pollution
- Acid rain and nutrient overloading
- Agricultural practices
- Overgrazing
- Fire
- Soil erosion
- Land degradation and desertification
- Climate change
- Map of potential threats to soil biodiversity

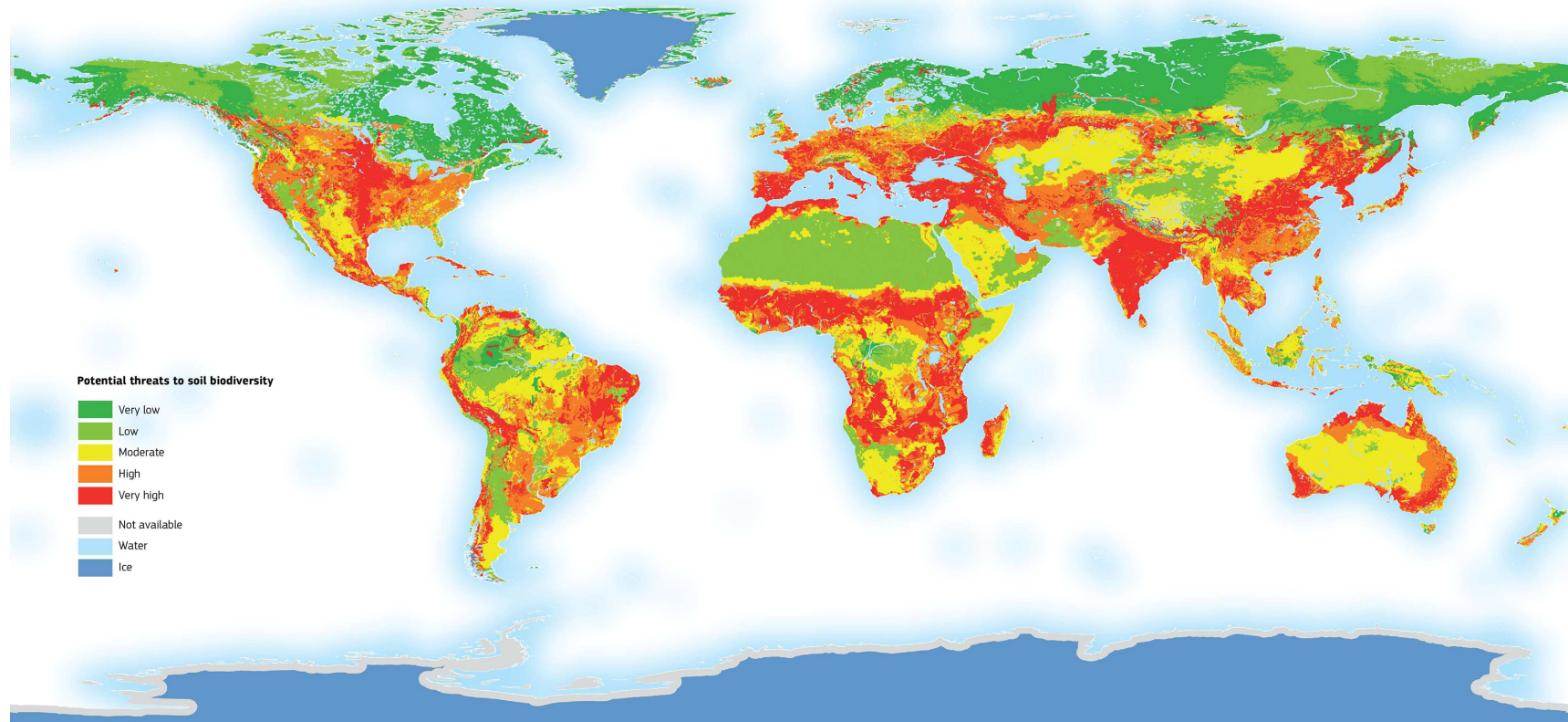
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CHAPTER 5 THREATS



Map of potential threats to soil biodiversity



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CHAPTER 6

INTERVENTIONS

- Agroforestry, afforestation and reforestation
- Prevention and restoration of invaded sites
- Bioremediation
- Diversification of cropland
- Land sparing versus land sharing
- No-till farming
- Fire management
- Soil erosion control
- Soil amendments



CHAPTER 6

INTERVENTIONS

- Suitable actions to protect soil biota are still missing
- Actions to conserve soil organisms are possible
- Sustainable management of soils
- Need to identify priorities
- Not only farmers and stakeholders, also common people should be involved

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Introduction

A significant and increasing proportion of the Earth's land area is covered by crop- and rangelands. Agricultural landscapes hold a large proportion of the world's biodiversity, but knowledge of the relative contribution of each land management type to the conservation of soil biodiversity, the maintenance of ecosystem functions, and the provision of ecosystem services is limited (1671).

Soil is the critical and dynamic regulatory centre of the majority of ecosystem processes. Soil organisms contribute to a wide range of ecosystem services that are essential to the sustainable functioning of natural and managed ecosystems. As mentioned in earlier sections of this atlas, highly diverse soil biological communities are largely linked to the high diversity of niches found in the soil environment, which are fostered by the extremely high physical and chemical heterogeneity at small scales, as well as the different microclimatic characteristics and functions of organisms that promote the development and maintenance of niche diversity.

Conservation of soil biodiversity in agricultural landscapes is thus intrinsically linked to land use and management systems that conserve and promote soil niche diversity. Recent evidence has shown that there are strong links between aboveground biodiversity (vegetation/crops) and belowground biodiversity (soil organisms). This finding supports the concept that modifications in plant communities as a result of changes in land use and agricultural systems can have profound impacts on the niche diversity underpinning soil biodiversity. Furthermore, it highlights the great potential to strategically utilise land management systems to influence the provision of soil-mediated ecosystem services. Limited predictive understanding of plant-soil feedbacks, however, still constrains the ecological management of soil biodiversity.

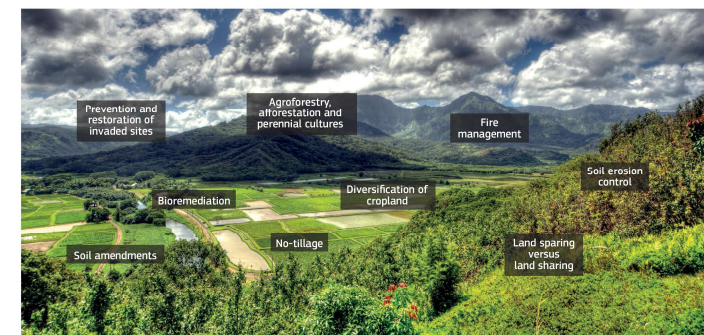
In this section, we will explore different ways in which soil can be managed to conserve soil biodiversity and sustain soil-mediated ecosystem functions and services. We start with a broad discussion about 'land sparing versus land sharing' as biodiversity conservation strategies. This is followed by efforts to address ecosystem restoration challenges associated with invasive species and pollution, as well as large impact systemic changes imposed by the diversification and intensification of agricultural landscapes. Next, follows management practices that have been adopted with significant impacts on soil biodiversity, including no-tillage systems and fire management. We conclude with more specific management practices, such as erosion control measures, the application of biochar and other soil reconstruction methods.

What can we do to protect soil biodiversity?

- Support soil-friendly cultivation that minimises the use of chemical fertilisers or pesticides. Look for organic products in the supermarket.
- Try to provide opportunities to encourage soil biodiversity where you live. Leave parts of your garden unmanaged, allow branches and garden waste to rot naturally.
- Reduce your 'carbon footprint'. Recycle where possible so that we minimise the chances of soil pollution.
- Think about your 'carbon footprint'. How are you contributing to global warming and climate change? Look at your energy consumption, try to use a bicycle or public transport instead of a car.
- Support woodland regeneration schemes.
- Encourage your local authorities to target new developments on brownfield sites so as to minimise their environmental impact. Limit, where possible, the sealing of surfaces by concrete or asphalt.
- Limit soil erosion, organic matter decline, compaction, salinisation and landslides, by identifying and communicating risk areas to land owners and local authorities.
- Carefully dispose of old medicines. Several pharmaceuticals can have significant impacts on organisms. Take old drugs to the pharmacy. Never flush them down the toilet.



1671. We can contribute to soil biodiversity preservation through many simple actions, such as: (a) supporting soil-friendly initiatives, (b) conserving or organic rubbish and (c) preserving aboveground biodiversity and (d) natural predators to reduce the use of pesticides. (POTI, JGI, USANGLISA, GFA)



1672. There are several actions that can facilitate conservation of soil-biodiversity, which can be identified when looking at the environment around us. Most of the measures would be possible through a better management of human activities. From: Biodiversity 2010: The State of the World's Biodiversity for Ecosystem Services (WRI, 2010).

CHAPTER 7

POLICY, EDUCATION AND OUTREACH

- Policies for soil biodiversity
- Historical knowledge
- Research into soil biodiversity
- Knowledge sharing
- Education and awareness
- Resources



CHAPTER 7

POLICY, EDUCATION AND OUTREACH

- Specific policies for soil biodiversity are needed
- Present services provided by soil biodiversity
- Talk about soil biodiversity
- Scientific research and participatory research
- Awareness events – play with soil biodiversity

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Policies for soil biodiversity

Biodiversity and policy

Society in general, and policy makers in particular, have neglected soil biodiversity. Initially, no attention was given to the large biodiversity pool stored belowground and only at a later stage, during the implementation of the Convention for Biological Diversity (CBD), was attention given to this important aspect of global biodiversity.



 Logo of the United Nations Decade on Biodiversity. (CBD)

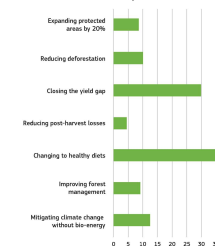
At its 6th meeting in Nairobi, April 2002, the Conference of the Parties (COP) of the CBD decided (COP decision W/5, paragraph 13) '...to establish an International Initiative for the Conservation and Sustainable Use of Soil Biodiversity as a cross-cutting initiative within the programme of work on agricultural biodiversity, and invite the Food and Agriculture Organization (FAO) of the United Nations, and other relevant organisations, to facilitate and coordinate this initiative'. Following that decision, an International Technical Workshop on the Biological Management of Soil Systems for Sustainable Agriculture was organised by the Brazilian Agricultural Research Corporation (EMBRAPA) and the FAO in Brazil in June 2002, to provide further elements for a coherent global approach to protecting the biological diversity of soils.



 Logo of the United Nations International Year of Biodiversity 2010. (CBO)

Progress made by the FAO in coordinating this initiative was reviewed at the 8th CBD COP in Curitiba, Brazil, in March 2006. The conference adopted a framework of action for the International Initiative for the Conservation and Sustainable Use of Soil Biodiversity. This framework was intended to facilitate the implementation at national, regional and global scales of the proposed main activities and actions. Unfortunately, only a few national governments and international organisations adopted the initiative and developed national or international soil biodiversity activities.

Avoided loss of mean species abundance

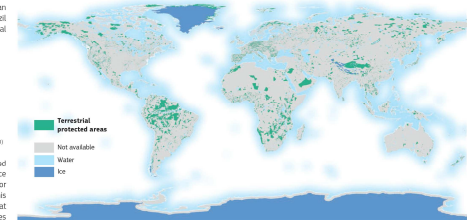


● Different scenario studies and assessments have considered biodiversity

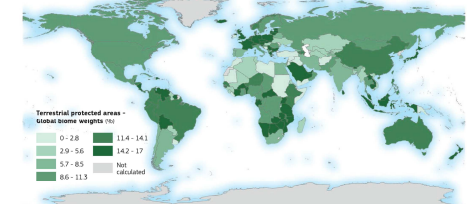
loss. At the same time, options to reduce this risk have been presented. For example, 'changing to healthy diets' has most impact on reducing loss of biodiversity as it implies a rethinking of the land use. All these actions are applicable following specific policies aimed at protecting biodiversity. Unfortunately, soil biodiversity is often not considered in this type of evaluation. In the future, assessments that take soil life into account will be desirable and necessary in order to preserve soil organisms (derived from Ten Brink et al., 2010; [18]).

Convention on Biological Diversity

- The Convention on Biological Diversity (CBD) is a multilateral treaty brokered by the United Nations. The Convention has three main goals:
 - conservation of biodiversity (or biodiversity);
 - sustainable use of its components;
 - fair and equitable sharing of benefits arising from genetic resources.
 - The Convention was signed for signature at the Earth Summit in Rio de Janeiro (Brazil) on 5 June 1992 and entered into force on 29 December 1993. One hundred and ninety-five states and the European Union are parties to the convention. All United Nations Member States, with the exception of the United States, have signed the Convention.
 - At the 10th Conference of the Parties (COP) to the Convention on Biological Diversity in October 2010 in Nagoya (Japan), the Strategic Plan for Biodiversity 2011-2020 was adopted, the plan for the halting and reversing/conserving the loss of biodiversity on Earth.
 - The Strategic Plan for Biodiversity 2011-2020 includes five strategic goals and 20 ambitious, yet achievable, targets to be reached by 2020. These are known as the Aichi Biodiversity Targets.
 - Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society.
 - Goal B: Reduce the direct pressures on biodiversity and promote sustainable use.
 - Goal C: Improve the status of biodiversity by combating direct pressures, including unsustainable use and genetic diversity.
 - Goal D: Enhance the benefits to all from biodiversity and ecosystem services.
 - Goal E: Increase institutional arrangements for biodiversity planning, knowledge management and capacity building.
- In 2010, governments agreed to the Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets.
- On 22 December 2010, the United Nations declared 2011 to 2020 as the UN Decade on Biodiversity.
 - The United Nations proclaimed May 22nd the International Day for Biological Diversity, and 2010 the International Year of Biodiversity.



2014 map of United Nations List of Terrestrial Protected Areas. The List gives an indication of the political commitment that countries have shown toward conservation. Also, it helps to track progress towards reaching the quantitative aspect of Aichi Biodiversity Target 11: how close we are to reaching 17% coverage of terrestrial areas and inland waters. While not explicit, it would be expected that soil organisms would also benefit from general conservation measures (derived from: IUCN and UNEP-WCMC, 2015. The World Database on Protected Areas – WDPAs) (L.J. JRC [1173])



The map shows an indicator of terrestrial protected areas that measures the percentage of terrestrial habitat that is protected. In particular, it takes into account the global contribution of a country's marine coastal zone. The global weight measures the percentage that a particular biome will matter more to a country compared at the global level. The degree to which a country protects a biome that is rare outside its borders may matter more than protecting a biome that is plentiful elsewhere.

20 Tropical and Subtropical Dry Broadleaf Forest; 21 Tropical and Subtropical Coniferous Forest; 40 Temperate Broadleaf and Mixed Forest; 51 Temperate Conifer Forest; 60 Boreal Forest and Tundra; 72 Mediterranean Forest, Woodland, and Scrub; 83 Temperate Deciduous Forest; 90 Desert and Shrubland; 94 Montane Grassland and Shrubland; 95 Savannah and Shrubland; 100 Flooded Grassland and Savanna; 111 Montane Grassland and Shrubland; 120 Tundra; 126 Desert and Semi-Desert; 140 Mangrove and Salt Marsh; and 151 Snow and Ice. The indicator calculation uses information provided by the CBD, UNEP, FAO, IUCN, and WWF.

2002. This indicator was calculated by a joint project between the Yale Center for Environmental Law and Policy (YCELP) and the United Nations Environment Programme World Resource Institute (UNEP-WRI). For additional information, see <http://www.yale.edu/ycelep>. [C0D173]

CHAPTER 8

CONCLUSIONS

- 1st ever Global Soil Biodiversity Atlas
- Reference publication
- 176 pages
- More than 900 images
- More than 50 maps
- Full of interesting stuff!

