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Organization of the
United Nations

GLOBAL SYMPOSIUM ON SOIL BIODIVERSITY

19-20-21-22
April 2021

Soil biodiversity: where are we and how it can help address global challenges

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University



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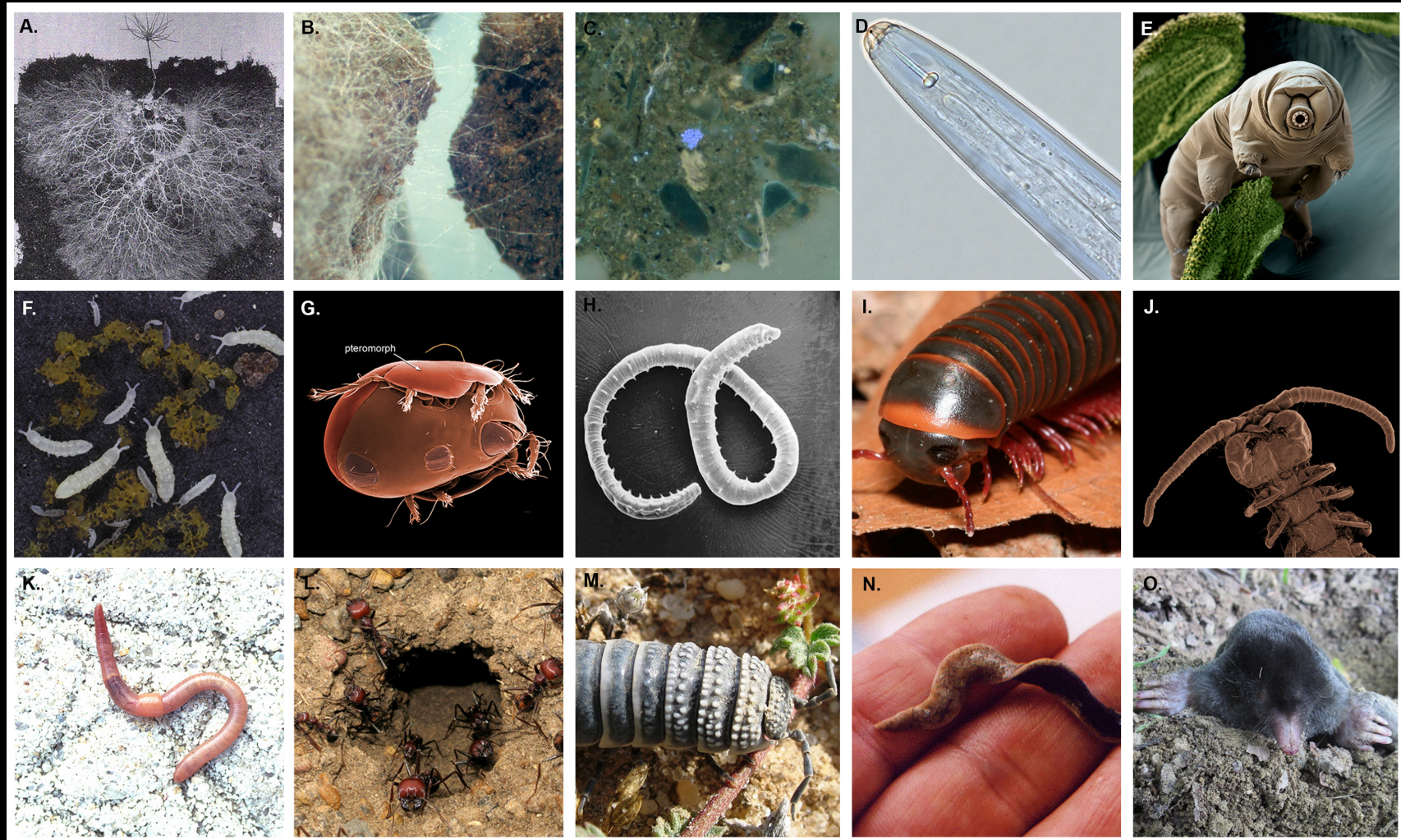
GLOBAL SOIL
PARTNERSHIP

Soils and soil biodiversity sustain the biodiversity we see



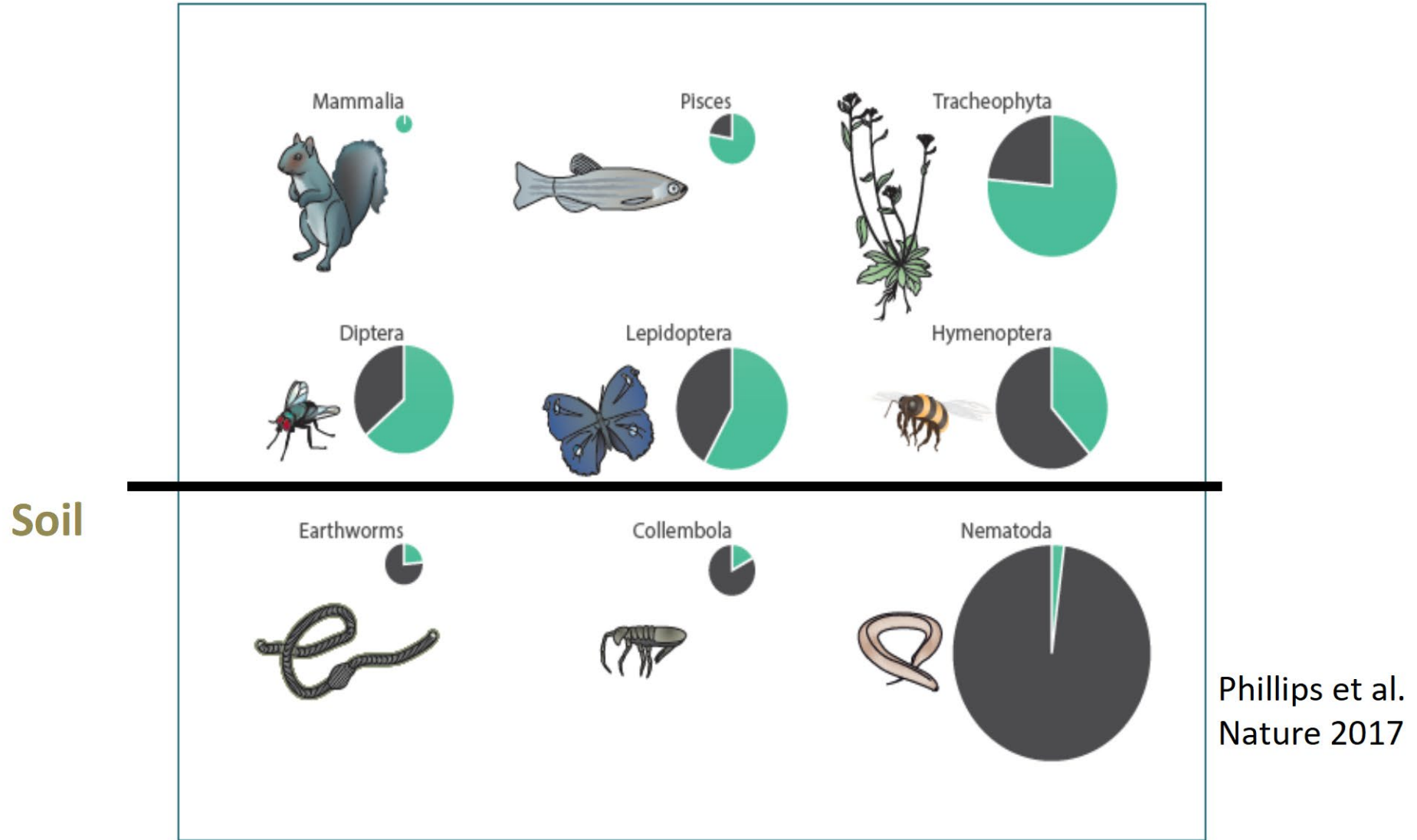
MICHAEL POLE / CORBIS

One quarter living diversity on Earth belowground



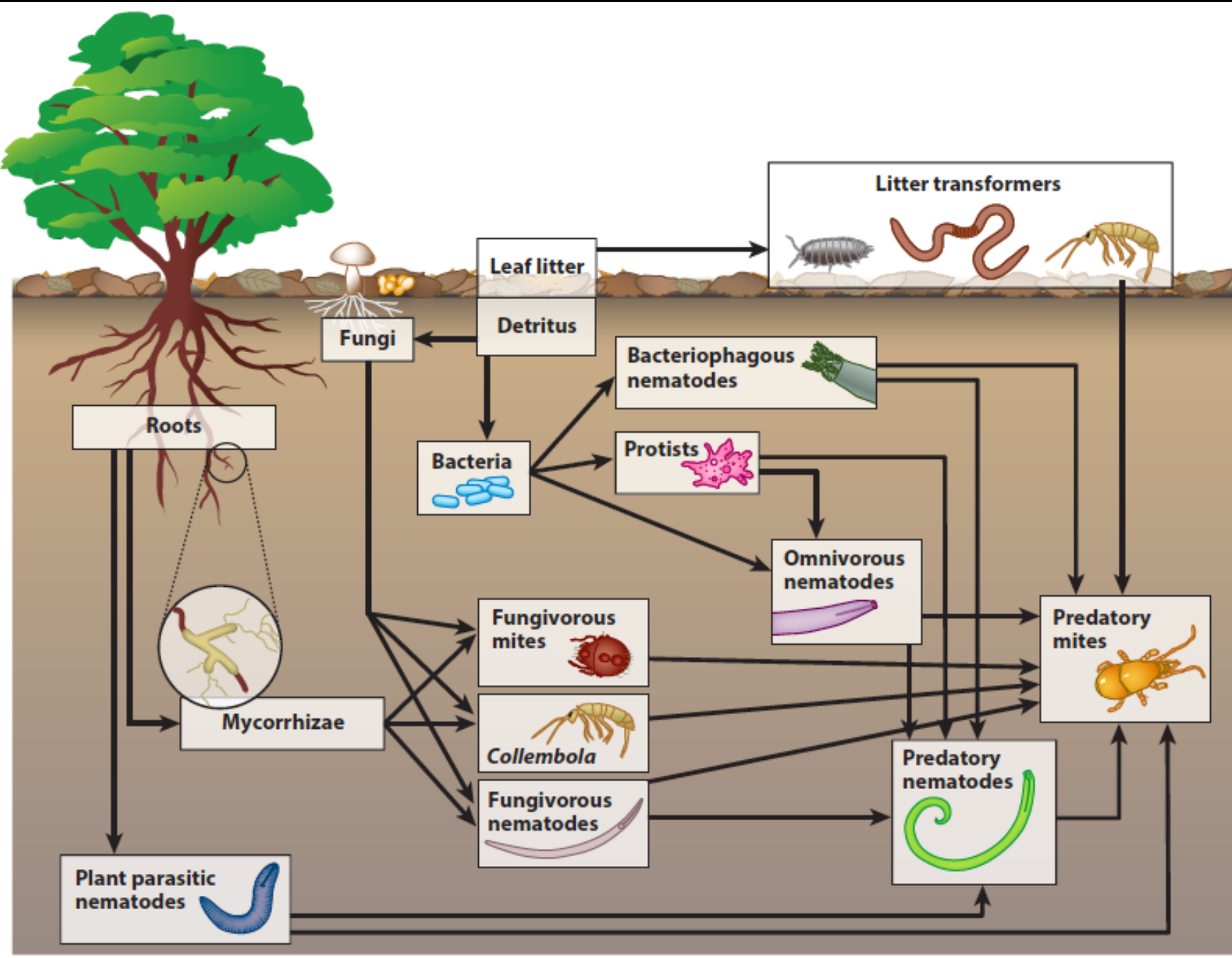
Bardgett and van der Putten (2014) Nature 515, 505-509.

Large, aboveground species are better described (green)

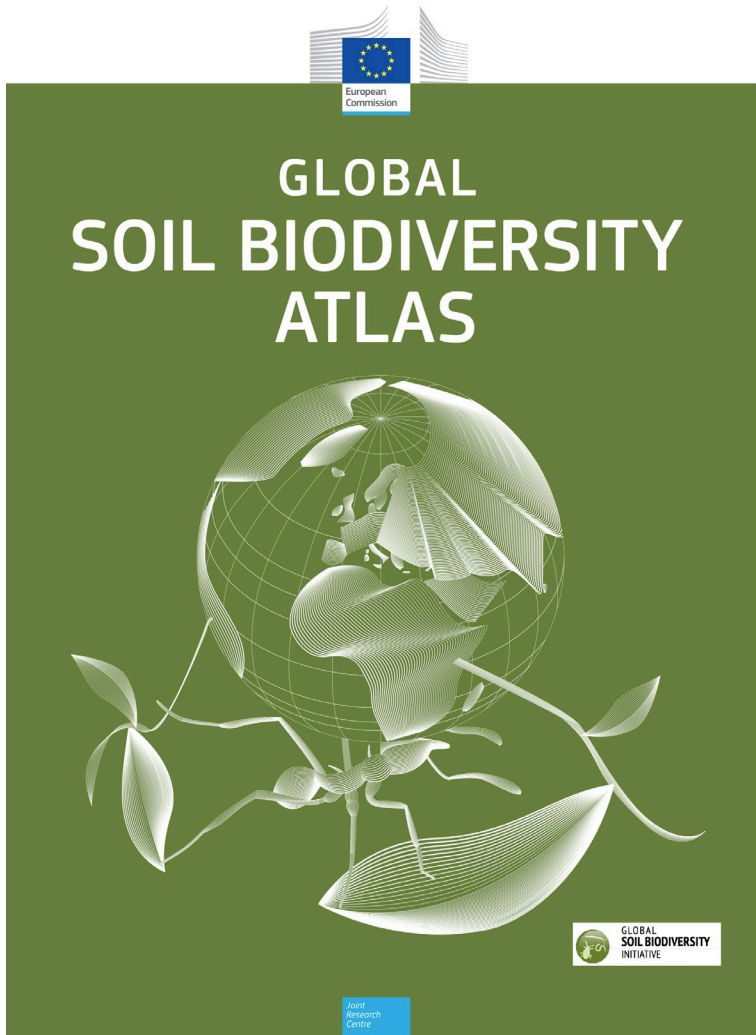


Phillips et al.
Nature 2017

Figure 1 | Proportion of described species (green) and estimated undescribed species (black) for six above-ground taxa (top two rows; estimates from ref. ¹²) and three below-ground taxa (bottom row; estimates from ref. ¹³). Size of the individual pie charts is proportional to the total number of estimated species.

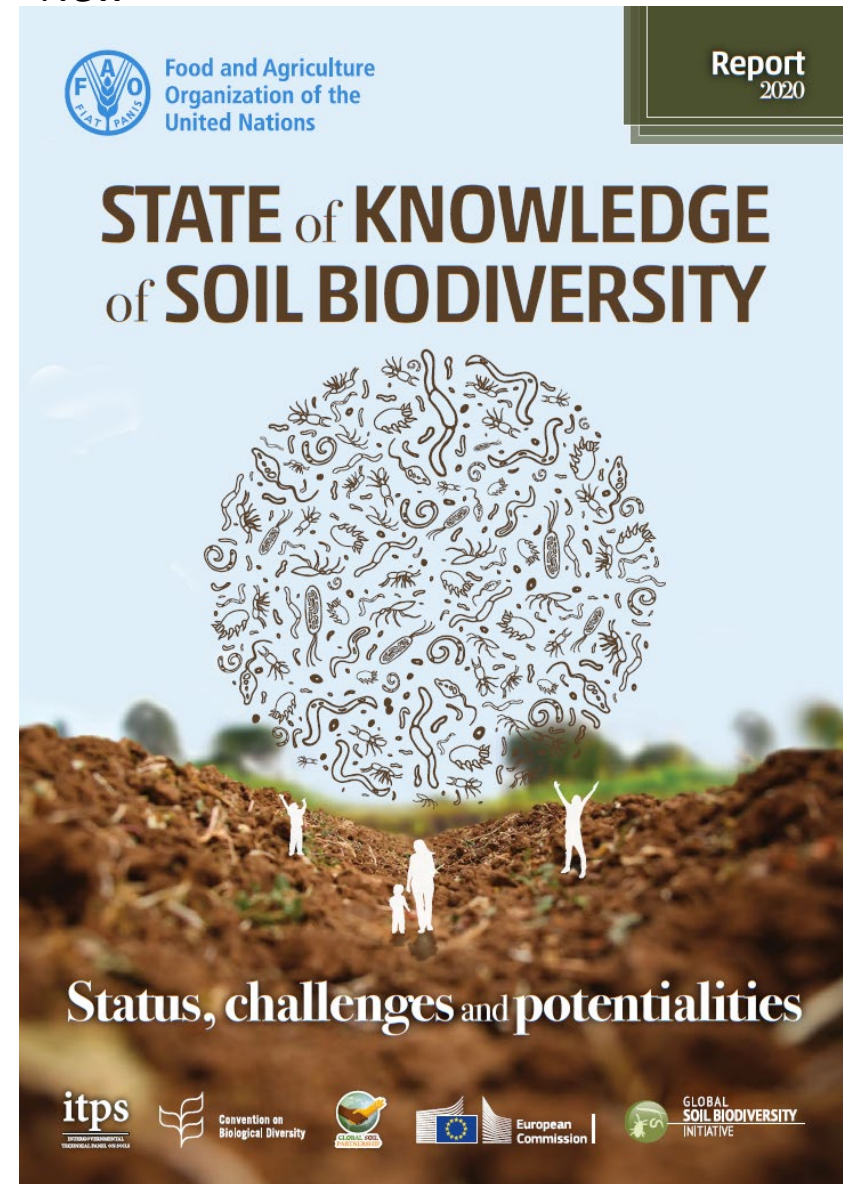


Nielsen, Wall and Six, 2015, *Ann. Rev. Env. Resources*



Origiuzzi et al. 2016, European Union.
Download free; single chapters download at
globalsoilbiodiversity.org/atlas-introduction

New



FAO, ITPS, GSBI, SCBD and EC. 2020. Rome, Italy.

Climate change, erosion, desertification, compaction, paving ~33% of soils are degraded



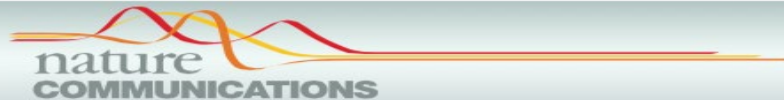
Phoenix, 2011 - present



Threats to Soil Biodiversity

Intensive agriculture reduces soil biodiversity across Europe

MARIA A. TSIAFOULI¹, ELISA THÉBAULT², STEFANOS P. SGARDELIS¹, PETER C. DE RUITER³, WIM H. VAN DER PUTTEN^{4,5}, KLAUS BIRKHOFFER⁶, LIA HEMERIK³, FRANCISKA T. DE VRIES⁷, RICHARD D. BARDGETT⁷, MARK VINCENT BRADY⁸, LISA BJORN LUND⁹, HELENE BRACHT JØRGENSEN⁶, SÖREN CHRISTENSEN⁹, TINA D' HERTEFELDT⁶, STEFAN HOTES^{10,11}, W.H. GERA HOL⁴, JAN FROUZ¹², MIRA LIIRI¹³, SIMON R. MORTIMER¹⁴, HEIKKI SETÄLÄ¹³, JOSEPH TZANOPOULOS¹⁵, KAROLINE UTESENY¹⁶, VÁCLAV PIŽL¹², JOSEF STARY¹², VOLKMAR WOLTERS¹¹ and KATARINA HEDLUND⁶



REVIEW

Received 25 Apr 2015 | Accepted 9 Oct 2015 | Published 23 Nov 2015

DOI: [10.1038/ncomms9862](https://doi.org/10.1038/ncomms9862)

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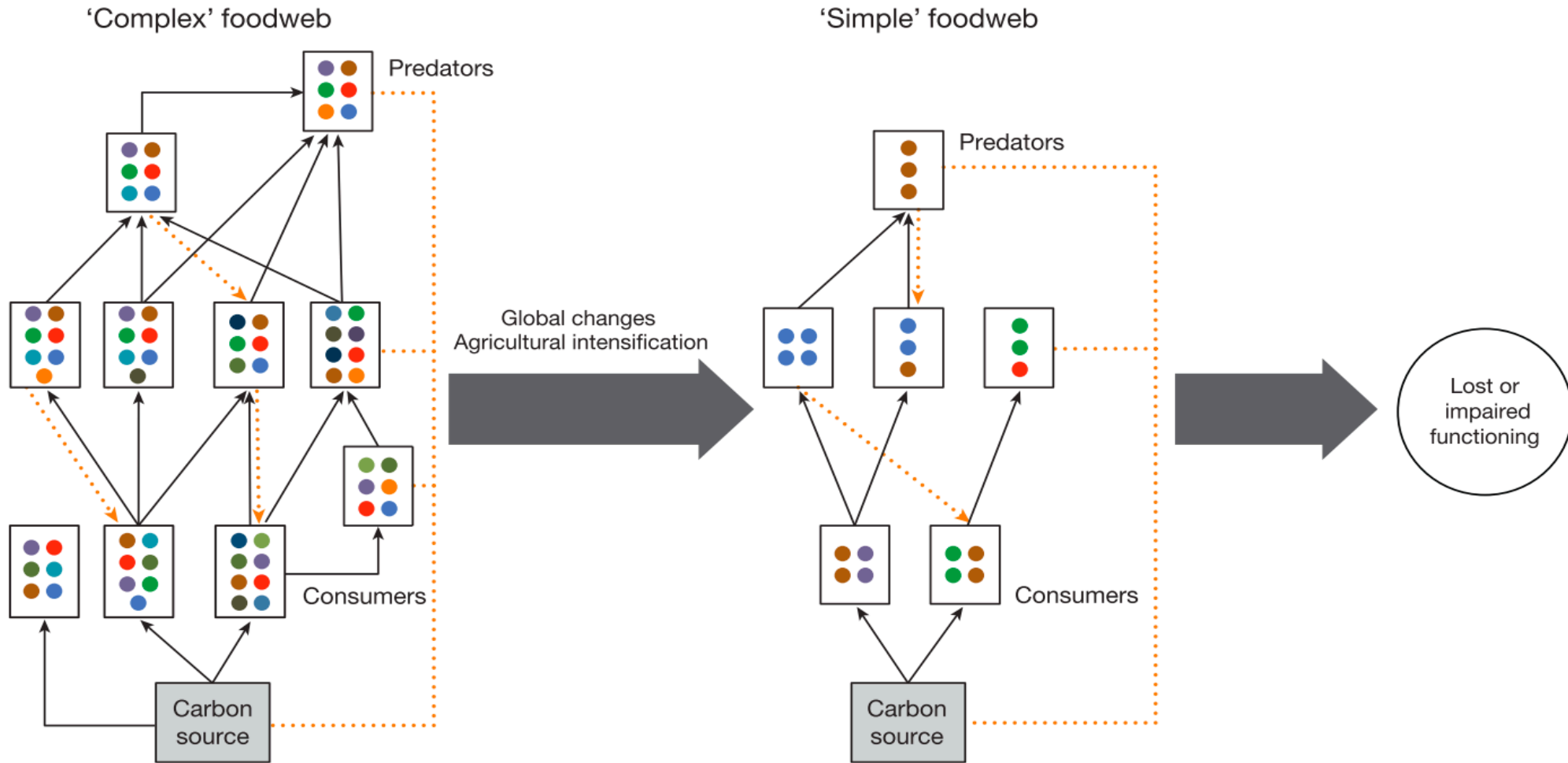
Extinction risk of soil biota

Stavros D. Veresoglou^{1,2}, John M. Halley³ & Matthias C. Rillig^{1,2}



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Soil foodweb connections are simplified with threats to soil



Soil biodiversity integrates agendas



Image by : Kristin Pintauro

Bach, Ramirez, Fraser, and Wall.
2020. *Sustainability* 12.

Soil biodiversity supports humanity

Journal of Applied Ecology 2015, **52**, 228–239

doi: 10.1111/1365-266



Image by : Kristin Pintauro

Soil biota enhance agricultural sustainability by improving crop yield, nutrient uptake and reducing nitrogen leaching losses

S. Franz Bender^{1,2*} and Marcel G.A. van der Heijden^{1,2,3}

PERSPECTIVE

3 DECEMBER 2015 |

nature
International journal of science

Soil biodiversity and human health

Diana H. Wall^{1*}, Uffe N. Nielsen^{2*} & Johan Six^{3*}

Soil biodiversity supports life above-ground



Image by: Kristin Pintauro

The values of soil animals for conservation biology

European Journal of Soil Biology 42 (2006)

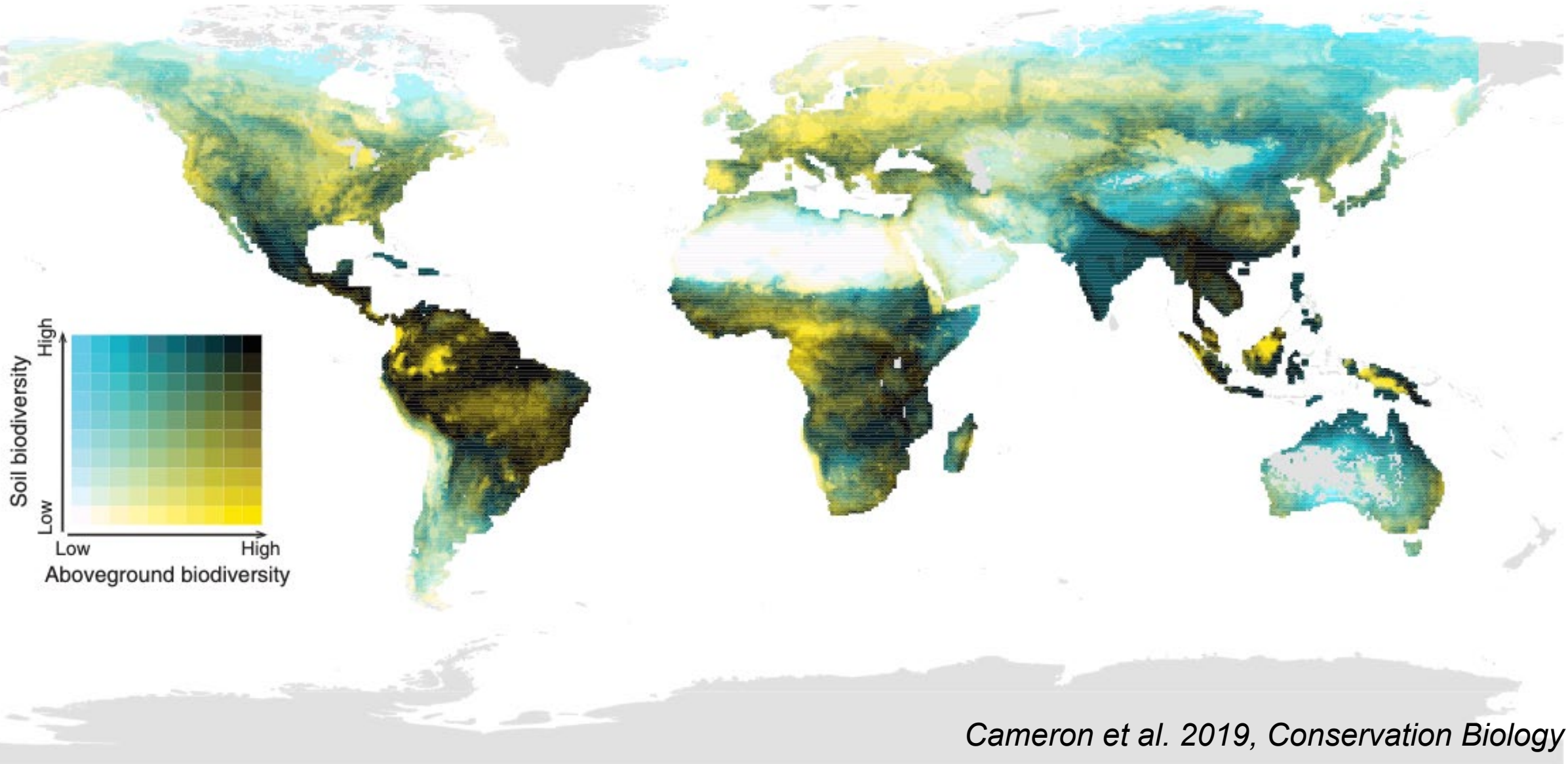
T. Decaëns^{a,*}, J.J. Jiménez^u, C. Gioia^c, G.J. Measey^b, P. Lavelle^b

Ecological roles and conservation challenges of social, burrowing, herbivorous mammals in the world's grasslands

Ana D Davidson^{1,2*}, James K Detling³, and James H Brown¹

Front Ecol Environ 2012; 10(9): 477–486,

Global mismatches in aboveground and belowground biodiversity



Cameron et al. 2019, Conservation Biology

Soil biodiversity regulates climate

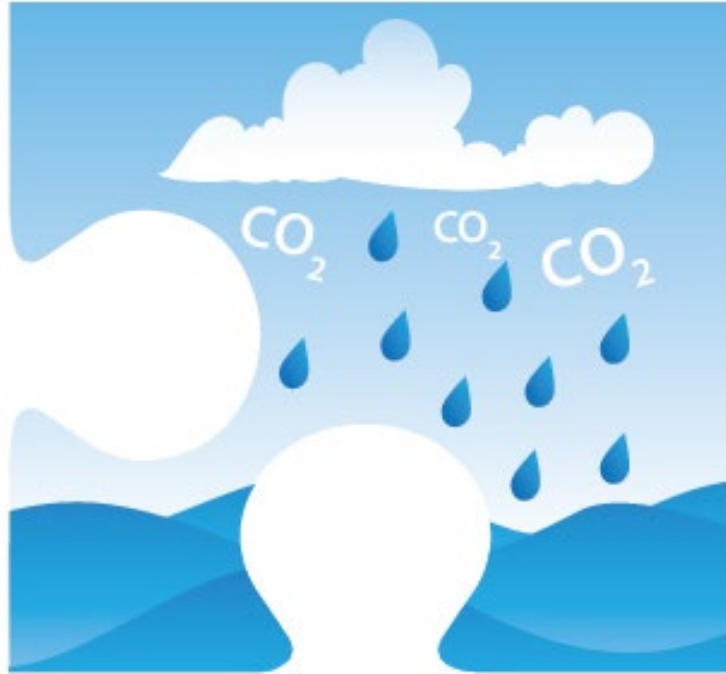


Image by : Kristin Pintauro

Annual Review of Ecology, Evolution, and Systematics 2017

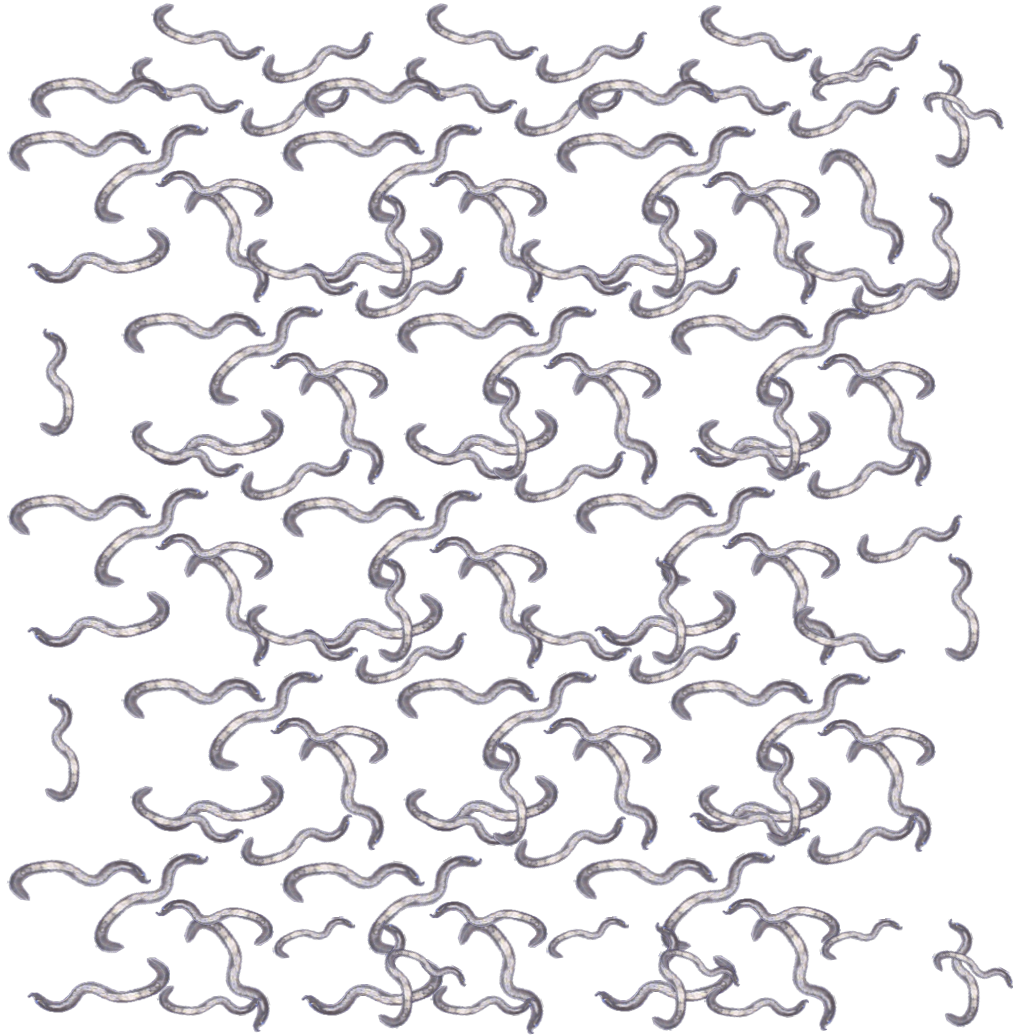
The Ecology of Soil Carbon: Pools, Vulnerabilities, and Biotic and Abiotic Controls

Robert B. Jackson,^{1,2,3} Kate Lajtha,⁴ Susan E. Crow,⁵
Gustaf Hugelius,^{1,6} Marc G. Kramer,⁷
and Gervasio Piñeiro^{8,9}

A meta-analysis of soil biodiversity impacts on the carbon cycle 2015. *Soil*, 1a(1), 257–271.

de Graaff, M.-A., Adkins, J., Kardol, P., & Throop, H. L.

Nematodes and other invertebrates contribute substantially to carbon cycling



Global soil nematode biomass is equal to
82% total human biomass on Earth
(~0.3 Gt or ~ 0.03 Gt Carbon)



CO₂ respired by nematodes is equivalent to
~ **15% of carbon emissions from fossil fuels**
~ **2.2% of total carbon emissions from soils**

Van den Hoogen et al. 2019. Nature.

Soil biodiversity filters water

Plant Soil (2015) 397:103–113
DOI 10.1007/s11104-015-2604-4

REGULAR ARTICLE

Anecic earthworms (*Lumbricus terrestris*) alleviate negative effects of extreme rainfall events on soil and plants in field mesocosms

Walter S. Andriuzzi · Mirjam M. Pulleman ·
Olaf Schmidt · Jack H. Faber · Lijbert Brussaard



Image by : Kristin Pintauro

Bach et al. 2020. *Sustainability*

The Influence of Soil Biodiversity on Hydrological Pathways and the Transfer of Materials between Terrestrial and Aquatic Ecosystems

R. D. Bardgett,^{1*} J. M. Anderson,² V. Behan-Pelletier,³ L. Brussaard,⁴
D. C. Coleman,⁵ C. Ettema,⁴ A. Moldenke,⁶ J. P. Schimel,⁷ and D. H. Wall⁸

Ecosystems (2001) 4: 421–429
DOI: 10.1007/s10021-001-0020-5

Soil biodiversity provides solutions

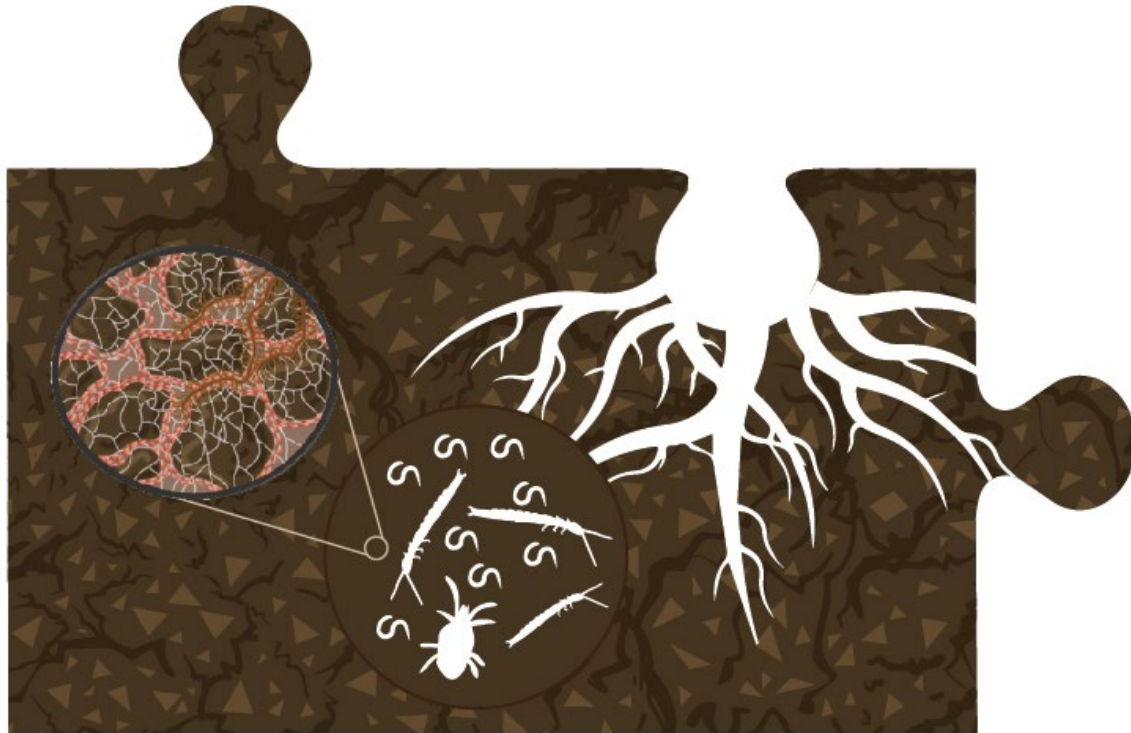


Image by : Kristin Pintauro

Conservation farming practices

Urban ecosystem management

Protecting natural areas

Ecosystem restoration

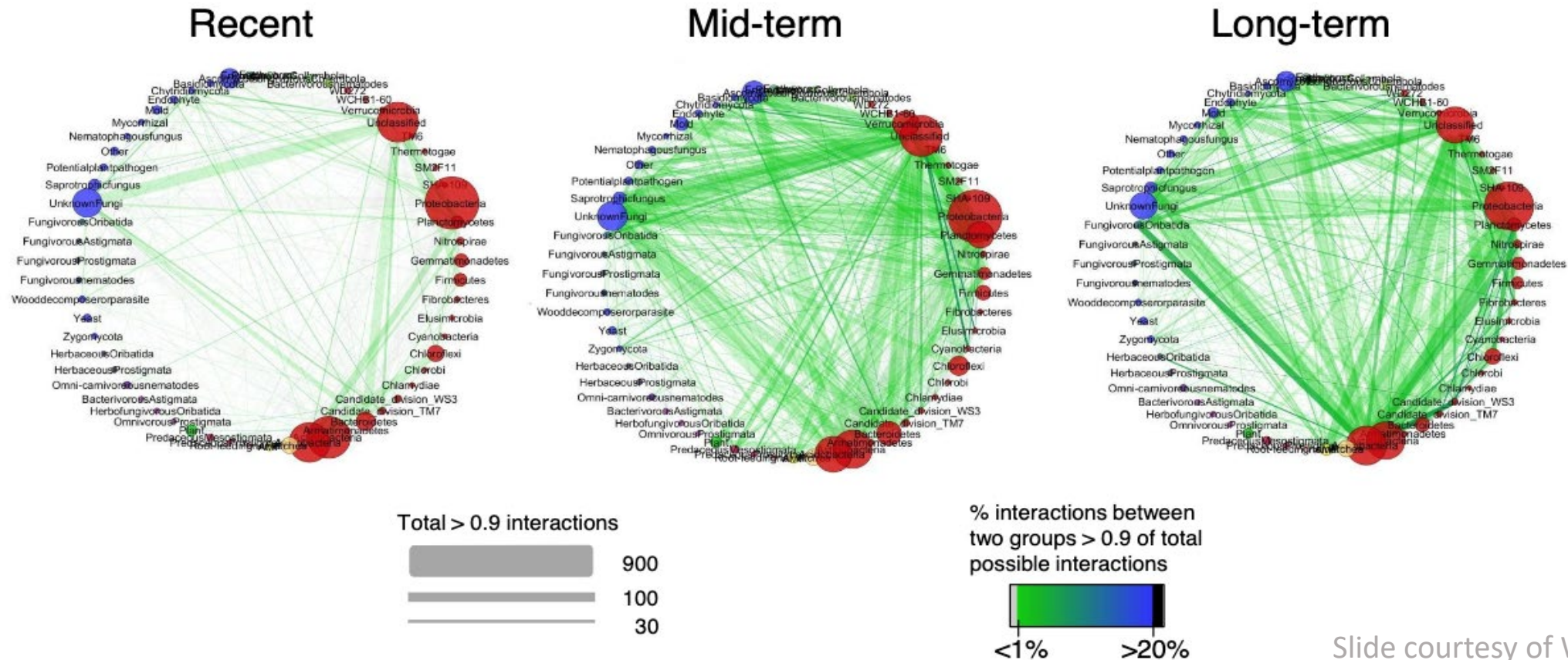
Soil biodiversity restores function Morriën et al.

Received 16 Jul 2016 | Accepted 19 Dec 2016 | Published 8 Feb 2017

DOI: 10.1038/ncomms14349

OPEN

Soil networks become more connected and take up more carbon as nature restoration progresses



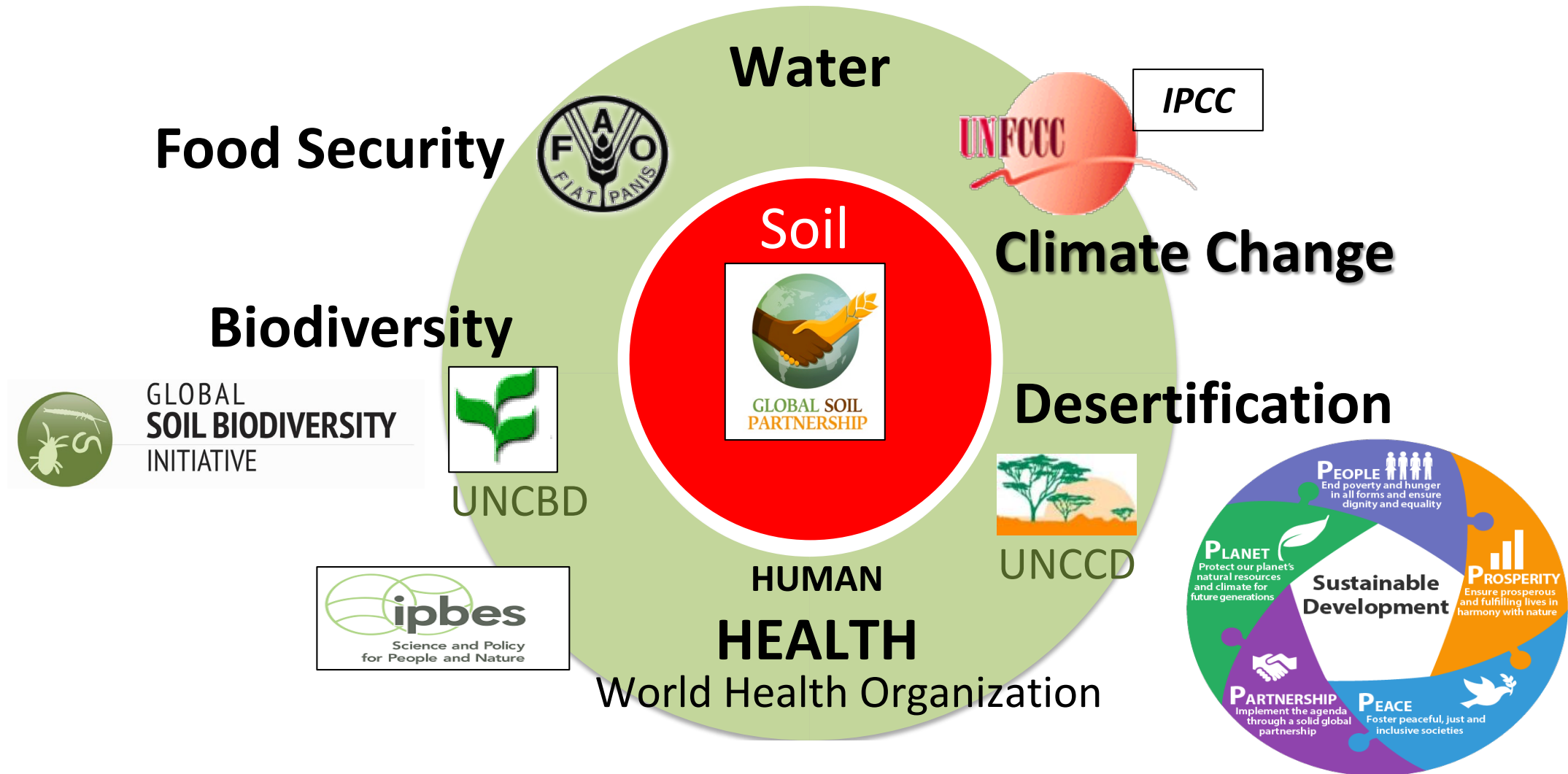
Soil biodiversity provides multiple benefits



Image by : Kristin Pintauro

Bach et al. 2020. *Sustainability*

How can soil biodiversity help address global challenges?

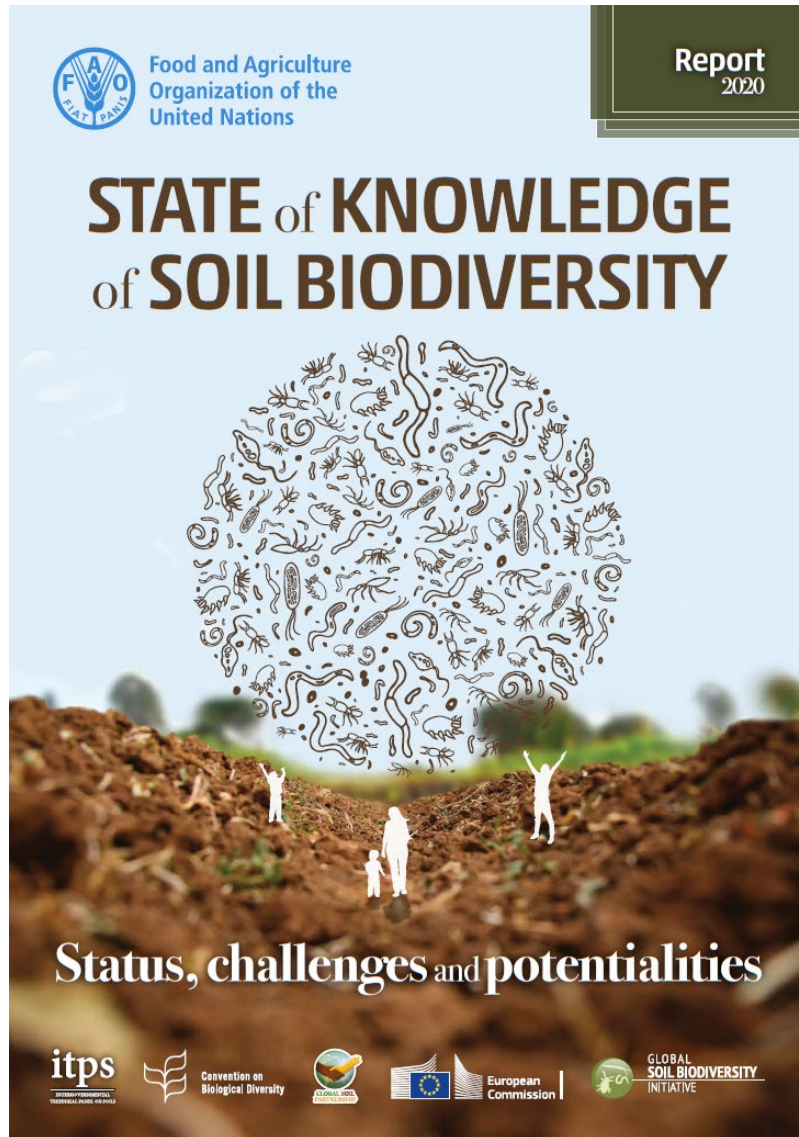




SUSTAINABLE DEVELOPMENT GOALS

 <p>SUSTAINABLE DEVELOPMENT GOALS</p>	<p>1 NO POVERTY</p> 	<p>2 ZERO HUNGER</p> 	<p>3 GOOD HEALTH AND WELL-BEING</p> 	<p>4 QUALITY EDUCATION</p> 	<p>5 GENDER EQUALITY</p> 
<p>6 CLEAN WATER AND SANITATION</p> 	<p>7 AFFORDABLE AND CLEAN ENERGY</p> 	<p>8 DECENT WORK AND ECONOMIC GROWTH</p> 	<p>9 INDUSTRY, INNOVATION AND INFRASTRUCTURE</p> 	<p>10 REDUCED INEQUALITIES</p> 	<p>11 SUSTAINABLE CITIES AND COMMUNITIES</p> 
<p>12 RESPONSIBLE CONSUMPTION AND PRODUCTION</p> 	<p>13 CLIMATE ACTION</p> 	<p>14 LIFE BELOW WATER</p> 	<p>15 LIFE ON LAND</p> 	<p>16 PEACE, JUSTICE AND STRONG INSTITUTIONS</p> 	<p>17 PARTNERSHIPS FOR THE GOALS</p> 

How can soil biodiversity help address global challenges?



Summary & Full Report free in multiple languages.

<http://www.fao.org/3/cb1929en/cb1929en.pdf>



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How can soil biodiversity help address global challenges?

Act now: develop a clear plan to protect and manage soil biodiversity on this planet.

Include soil biodiversity in the future Global Biodiversity Framework.

FAO and others help translate recommendations to action on the ground (Table 1, summary for Policymakers).

Establish the Global Soil Biodiversity Observatory



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Europe's Land Use and Cover
Area Soil survey (LUCAS)
coordinated by European Commission's
Joint Research Centre (JRC)

- **Largest soil monitoring program in Europe**
- In 2018, for the first time, 1000 samples **soil biodiversity assessment, 16S, ITS, 18S**

Orgiazzi *et al.*,
EJSS, 2018



A Global Soil Biodiversity Observation Network

To assess soil biodiversity and soil ecosystem functions in protected and non protected areas.

A grassroots initiative ...

Guerra et al. 2021. Science

<https://geobon.org/bons/thematic-bon/soil-bon/>

Global soil biodiversity needed for a sustainable future



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Atlas.globalsoilbiodiversity.org

Global Soil Biodiversity Atlas, Orgiazzi et al. 2016



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