Protisten, belangrijke en wonderlijk organismen

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Personal introduction

- Assistant Prof since 2019 @ Wageningen Uni, Nematology
- Focus: soil biodiversity, microbiome, ecology
- NWO Veni, EU Horizon, COST...
- Top 10 Biodiversity Researcher in Nl
- Guest Prof Nanjing Agriculture Uni
- Scientific Editor (in Chief, Field/Section and board)
- Board member NWO RC
- *Beyond work...*

Biodiversity research in the Netherlands and worldwide

What published academic research tells us

Video on Soil Biodiversity

- Title: Keep soil alive, protect soil biodiversity
- Duration: 5m 20s
- Organization: Food and Agriculture Organization (FAO) of the United Nations
- Location: Youtube: https://www.youtube.com/watch?v=hbdsHOnd_gw

(Soil) Complexity

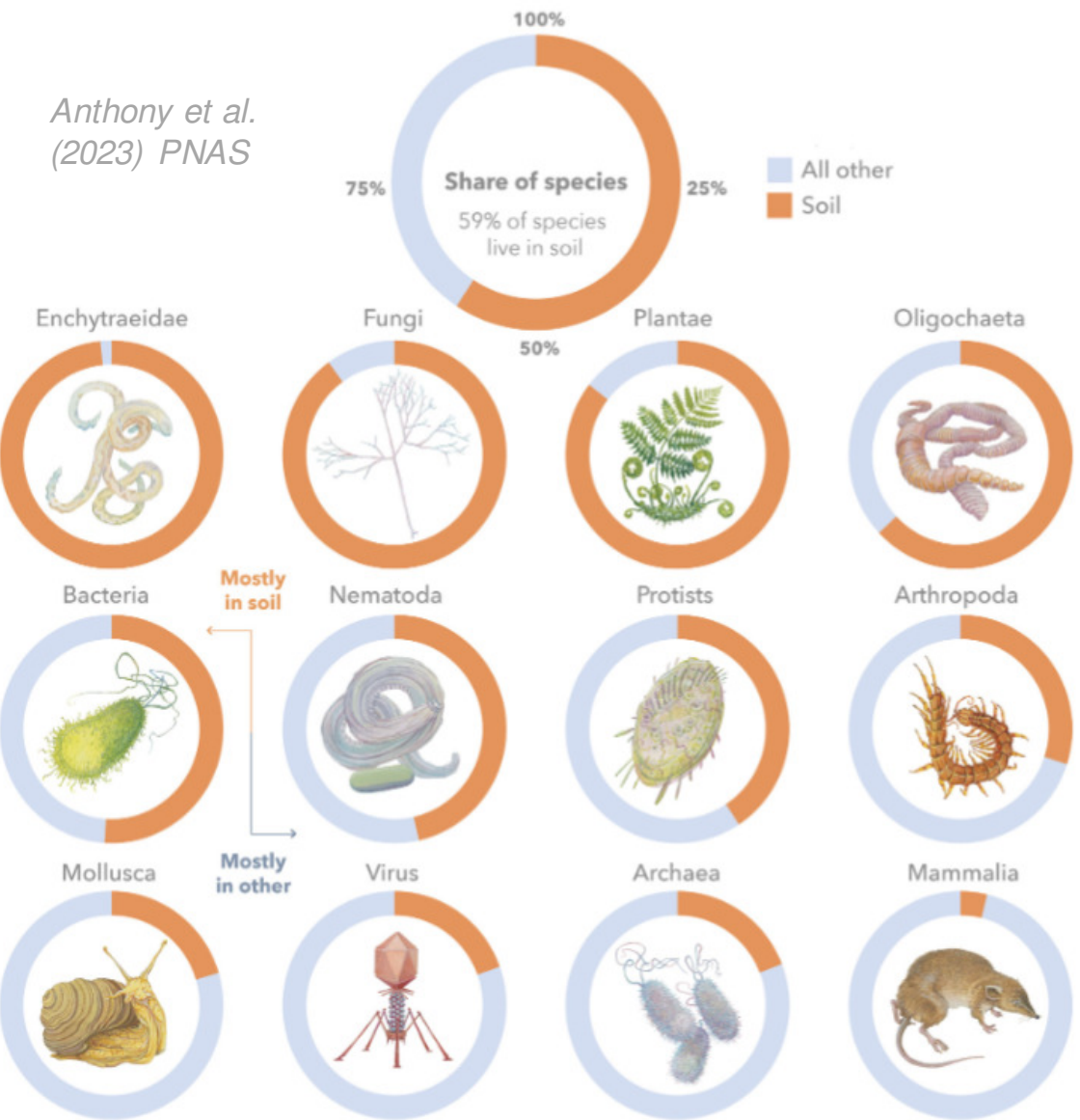
Soil is...

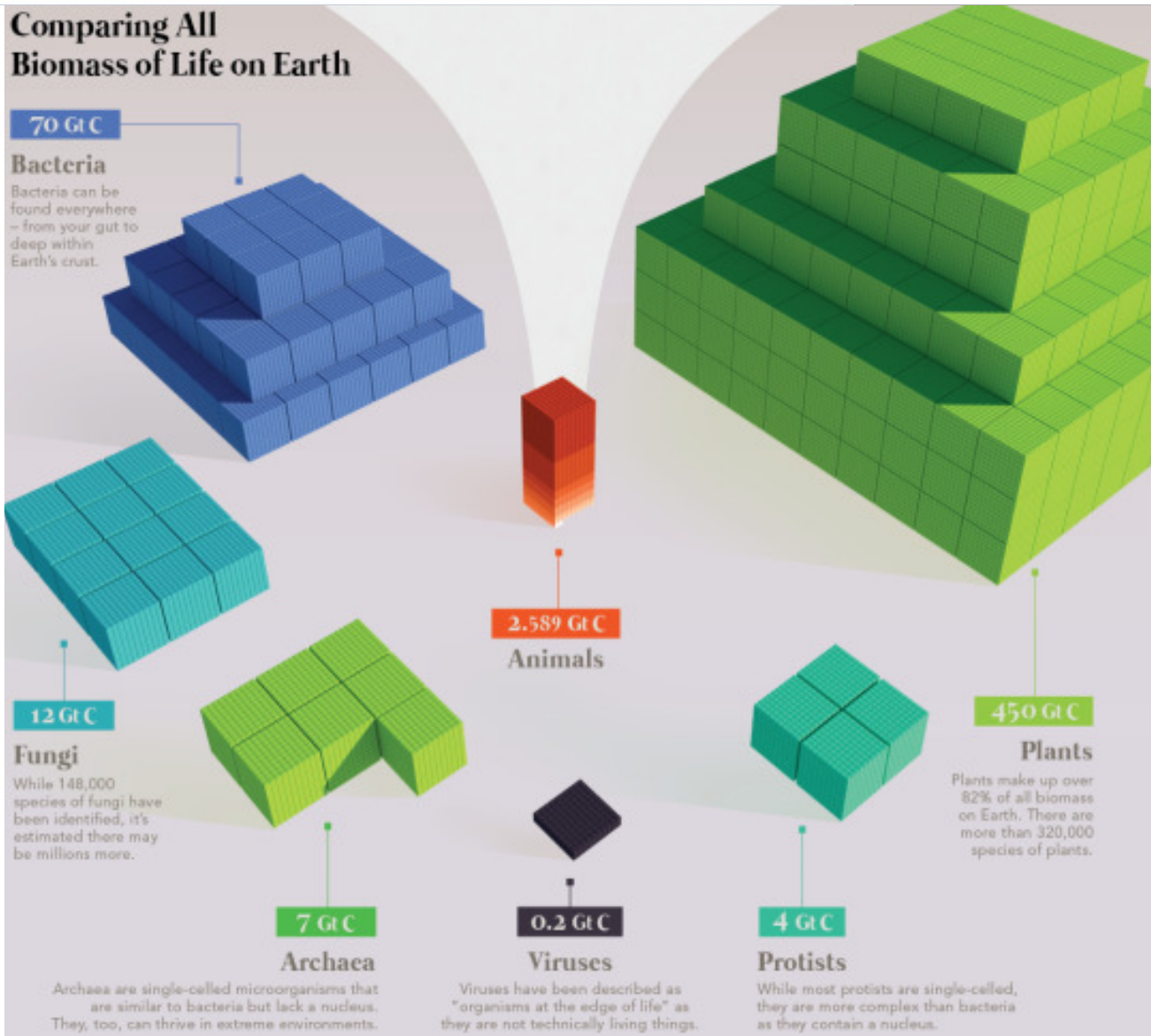
a nightmare

Geisen et al. (2019) SBB

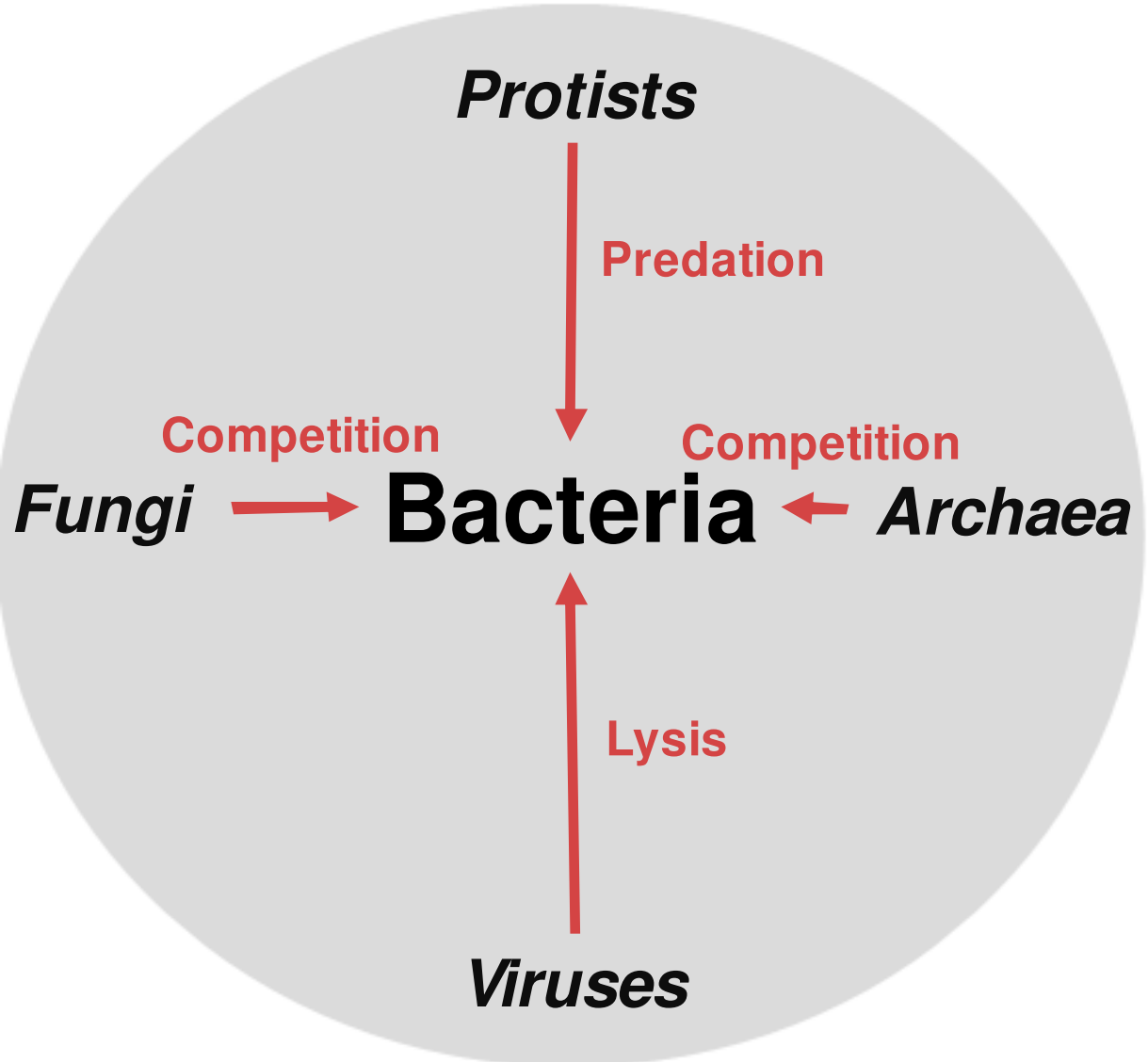
Soil Biodiversity

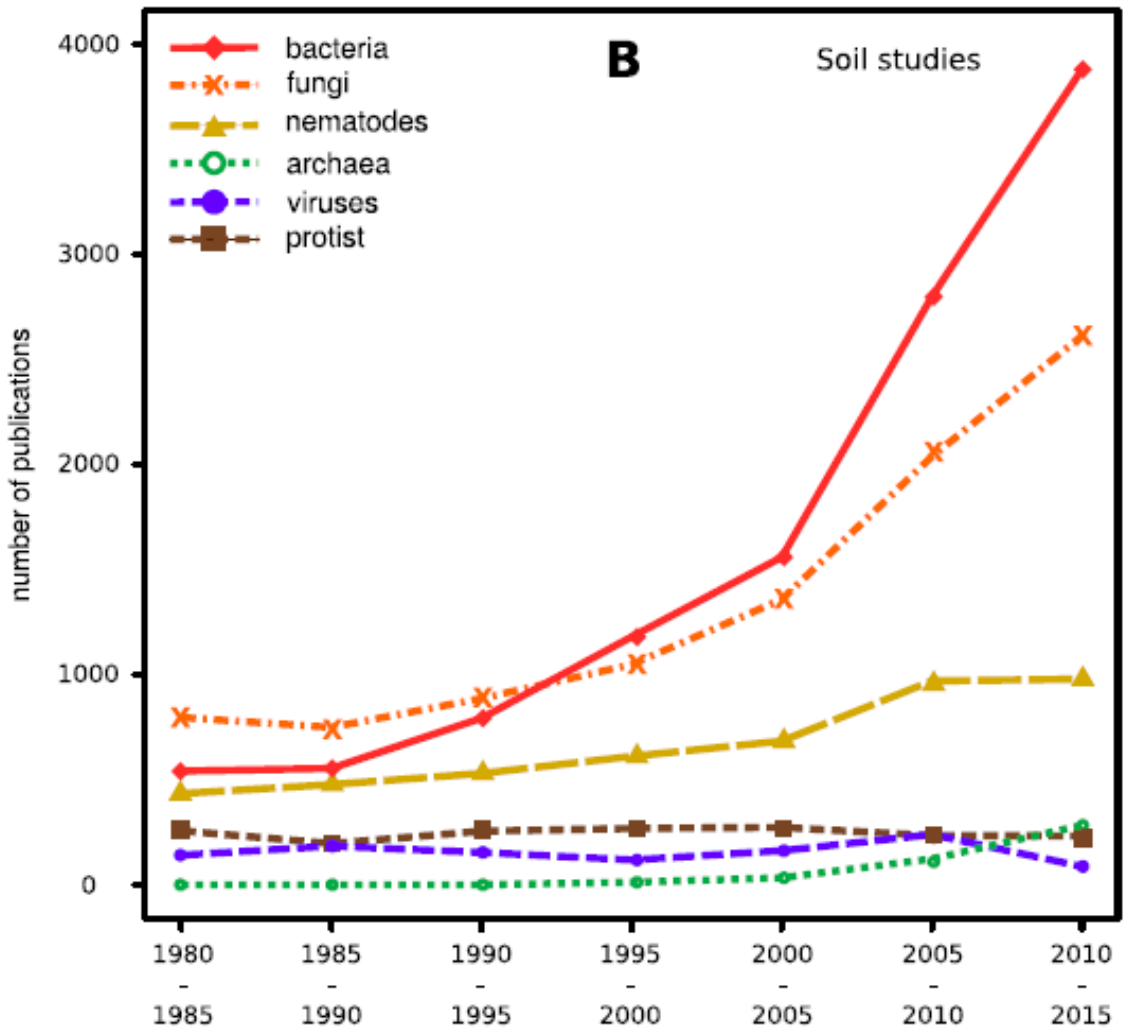
Anthony et al. (2023) PNAS





Microbiome?


Protists
Predation
Competition
Competition
Fungi
Bacteria
Archaea
Lysis
Viruses

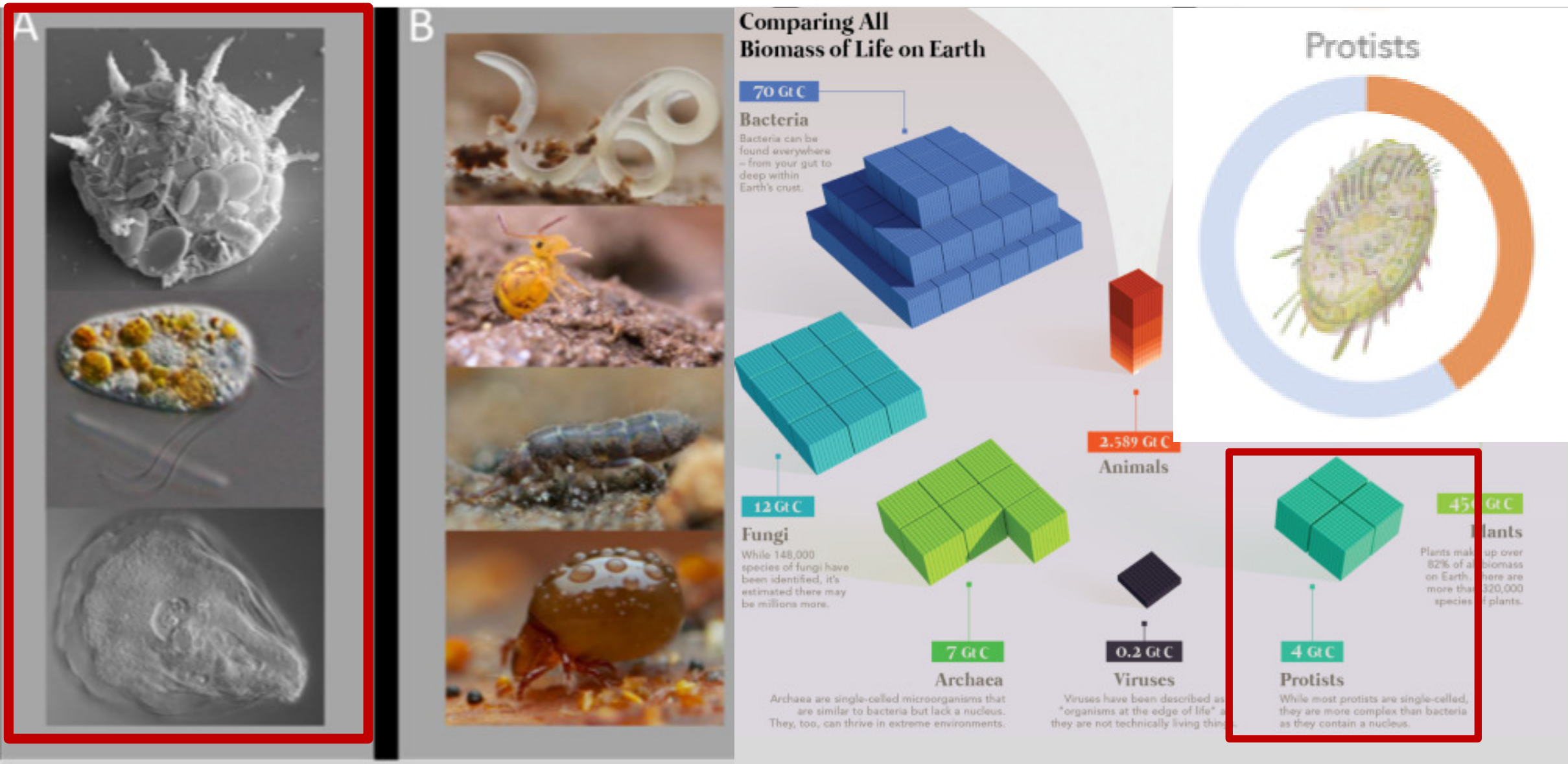

B
Soil studies
bacteria
fungi
nematodes
archaea
viruses
protist
number of publications
4000
3000
2000
1000
0
1980 - 1985
1985 - 1990
1990 - 1995
1995 - 2000
2000 - 2005
2005 - 2010
2010 - 2015

The Soil Microbiome and its Predators

Thakur & Geisen (2019)
Trends in Microbiology

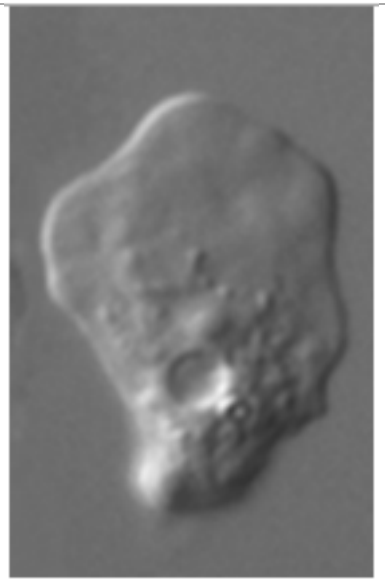
Protists????

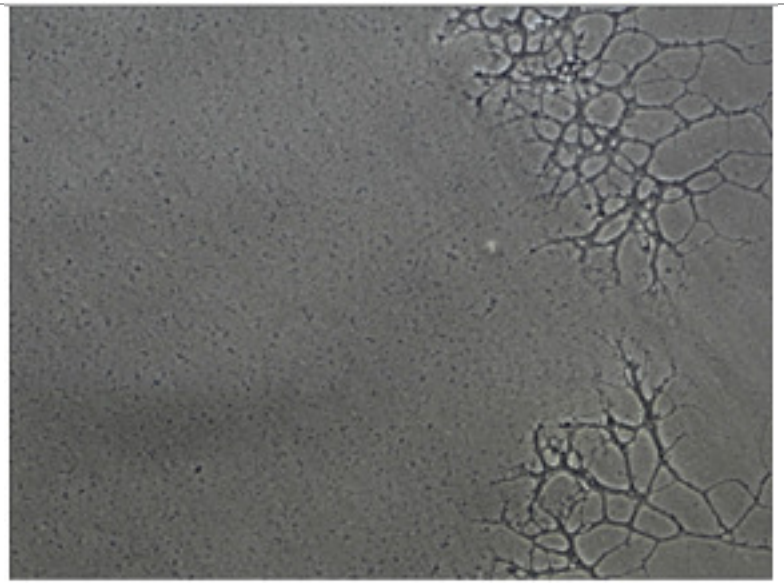
Protists


A
B
Comparing All
Biomass of Life on Earth
70 Gt C
Bacteria
Bacteria can be found everywhere – from your gut to deep within Earth's crust.
2.589 Gt C
Animals
12 Gt C
Fungi
While 148,000 species of fungi have been identified, it's estimated there may be millions more.
7 Gt C
Archaea
Archaea are single-celled microorganisms that are similar to bacteria but lack a nucleus. They, too, can thrive in extreme environments.
0.2 Gt C
Viruses
Viruses have been described as "organisms at the edge of life" a they are not technically living thing
4 Gt C
Protists
While most protists are single-celled, they are more complex than bacteria as they contain a nucleus.
Plants
Plants mak up over 82% of a biomass on Earth. here are more tha 320,000 species f plants.
Protists

Protists?

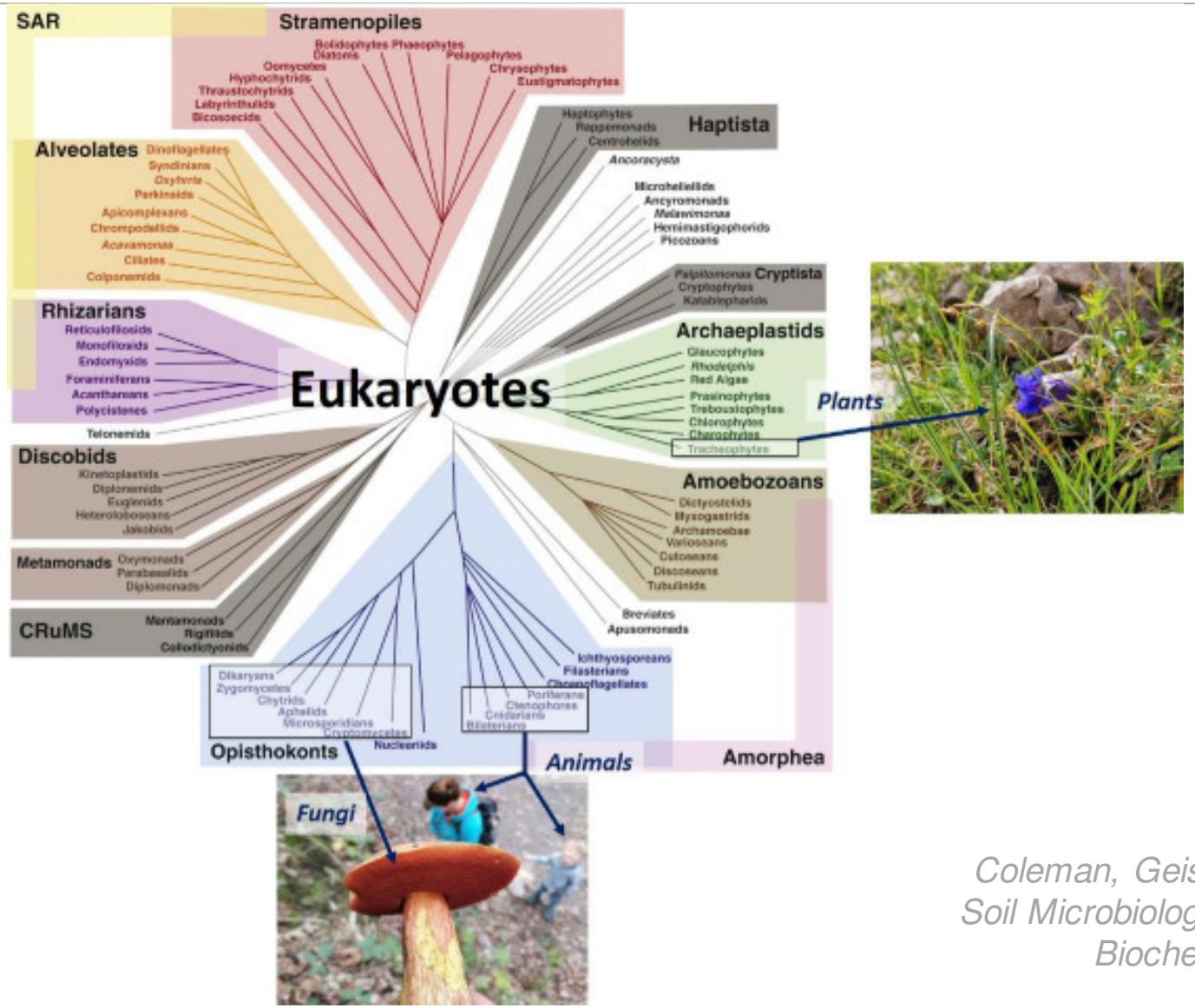
- Amoebae





- Pathogens

Taxonomic Biodiversity



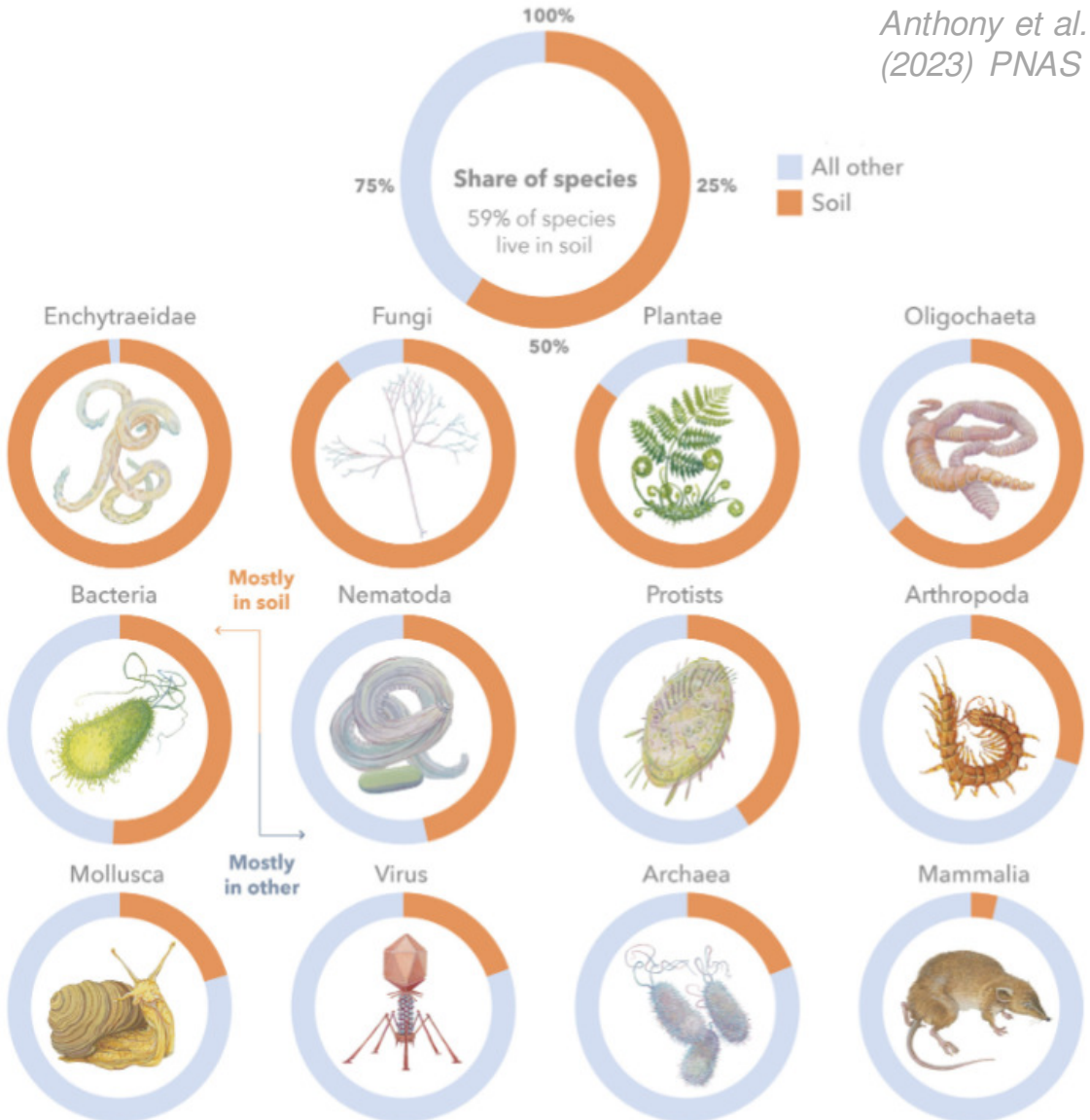
Coleman, Geisen, Wall 2024
Soil Microbiology, Ecology and Biochemistry

Protist species richness

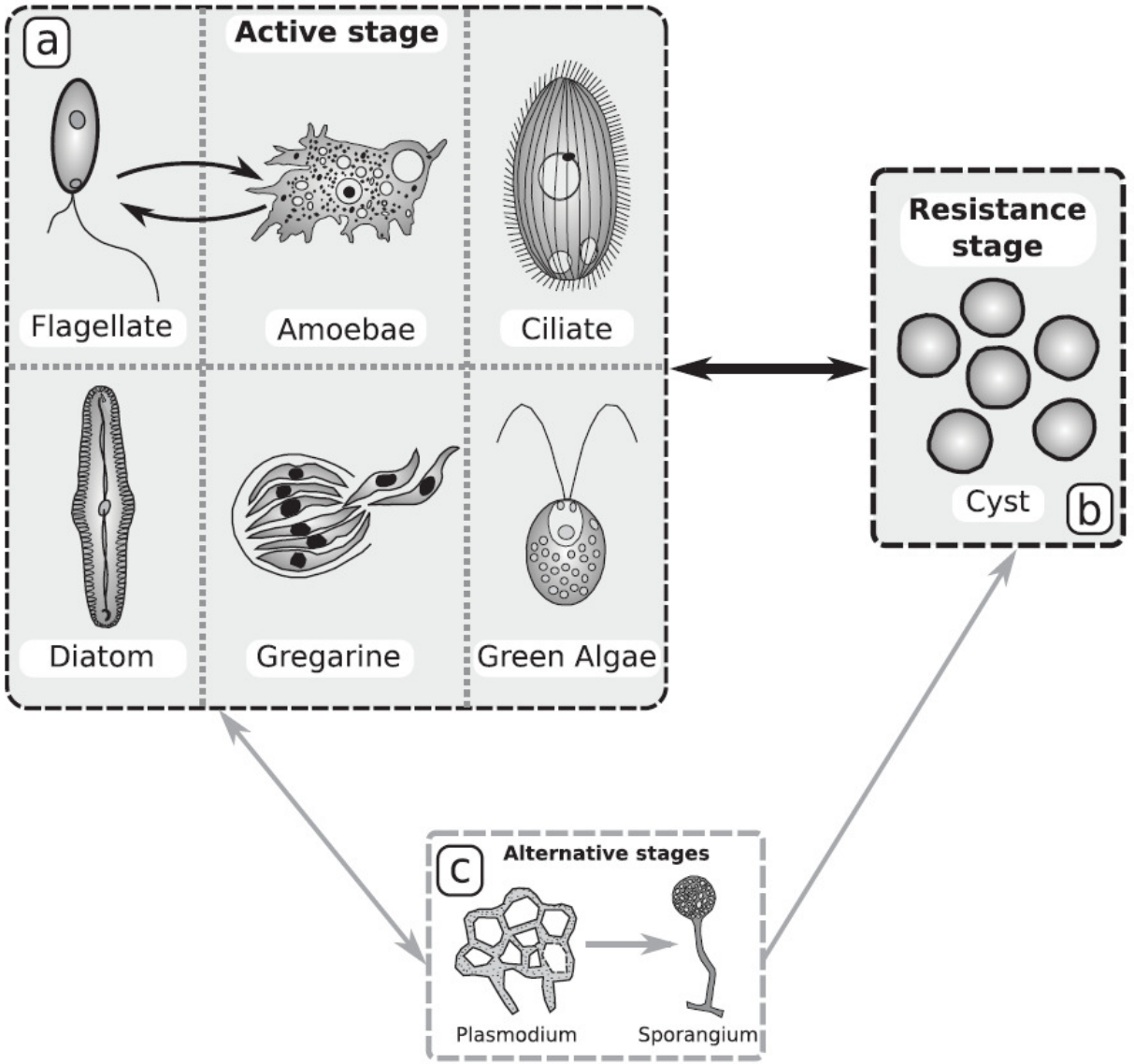
Anthony et al. (2023) PNAS

Table 1. Enumeration of biodiversity on Earth and in soil (Table view)

	Total species			
Macrobes	Lower	Central	Upper	Conf.
Mammalia	n/a	6.5×10^3 (16, 49)	4.5×10^4 (41)	H
Nematoda	5×10^5 (50, 51)	1×10^6 (33, 52)	1×10^8 (52)	L
Arthropoda	1.14×10^6 (53)	7×10^6 (32)	3×10^7 (54)[b,?]	M
Insecta	9.5×10^5 (53)	$5\text{-}5.5 \times 10^6$ (32, 41)	1×10^8 (55)[b,?]	M
Arachnida	9×10^4 (53)	1.1×10^5 (41)	7.5×10^5 (50)	M
Collembola	6.5×10^3 (56)	8.7×10^3 (53)	5×10^4 (57)	M
Diplopoda	1.3×10^4 (53, 58)	1.5×10^4 (58)	$7\text{-}8 \times 10^4$ (41, 59)	M
Isoptera	3×10^3 (53)	5.4×10^3 (60)	1×10^4 (7)	M
Formicidae	1×10^4 (53)	1.5×10^4 (61)	2.1×10^4 (62)	M
Oligochaeta	5×10^3 (63)	1×10^4 (64)	?	H
Enchytraeidae	7.1×10^2 (65)	7.8×10^2 (53)	1.2×10^3 (7)	H
Mollusca	8×10^4 (41)	1.2×10^5 (53)	2×10^5 (50)	H
Plantae	3.8×10^5 (53)	5.37×10^5 (64)	n/a	H
Microbes[k]	$6.7 \times 10^{6,k}$	$1.01 \times 10^{9,k}$	$1 \times 10^{12\text{-}14}$ (34, 66)[?]	L
Phage	1×10^8 (67)[?]	1×10^{11} (68)[l,?]	3.7×10^{11} (68)[l,?]	VL
Bacteria	$4.3\text{-}4.5 \times 10^6$ (19, 39)	1×10^9 (17)	3.7×10^9 (43)[n]	L
Fungi	2.2×10^6 (35)	6.2×10^6 (69)	1.65×10^8 (42)[p,?]	M
Archaea	1.1×10^4 (70)	1.9×10^5 (19)[r]	3.8×10^5 (19)[r]	L
Protists	6×10^4 (55)	$1\text{-}3 \times 10^5$ (12, 55, 71)	$8.4\text{-}16.2 \times 10^7$ (42, 72)[?]	L

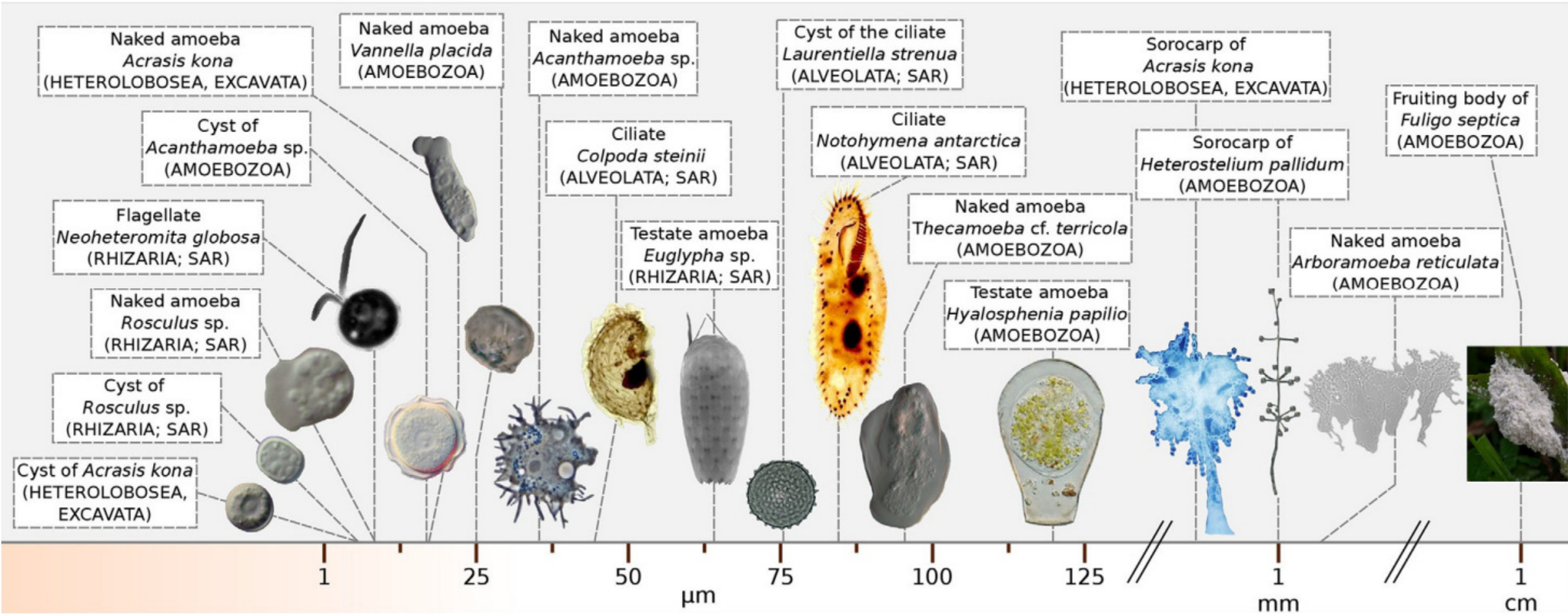


Protist Traits



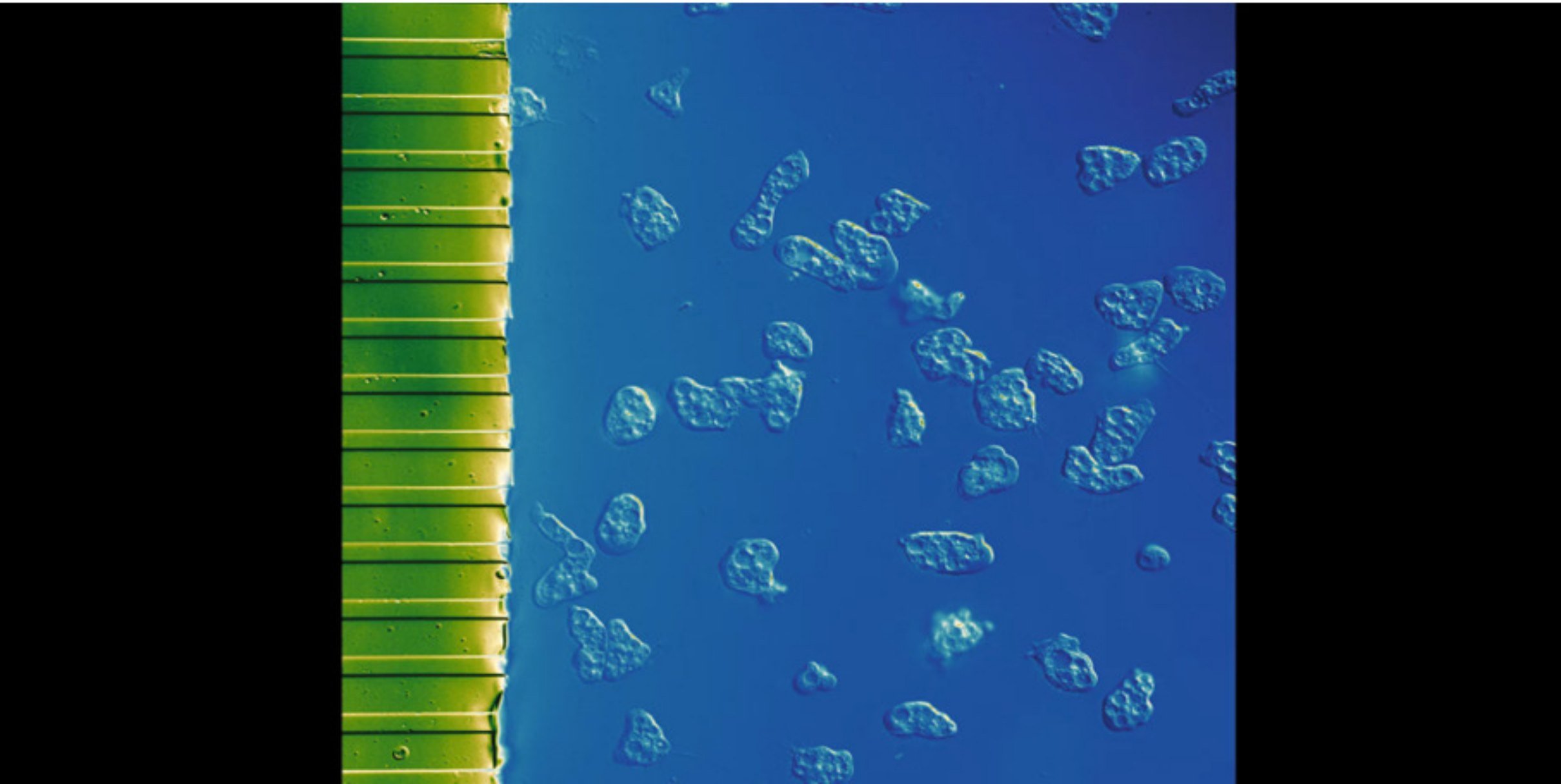
Geisen et al 2017 SBB

Trait Variation

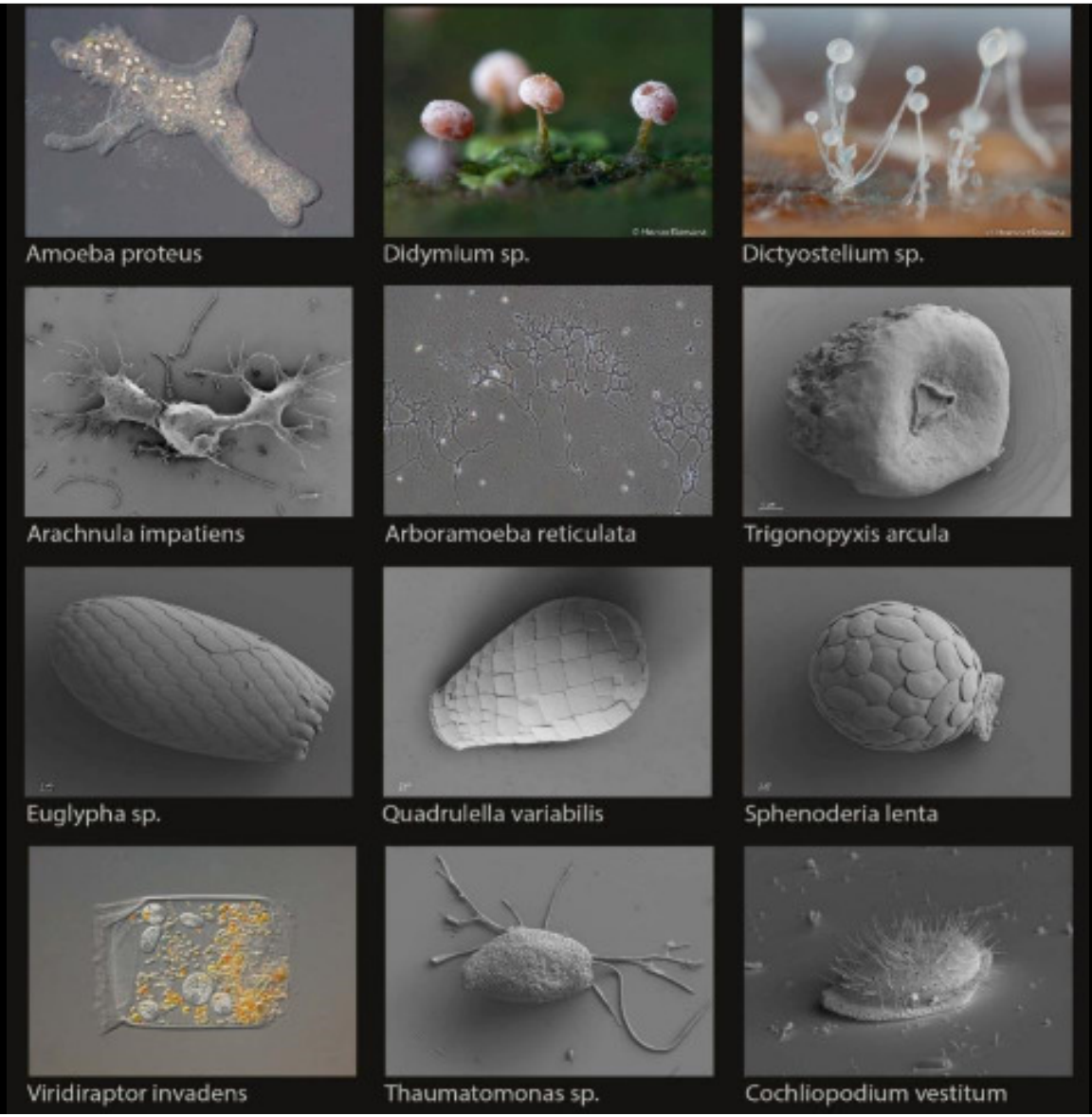


Geisen et al 2017 SBB

Cool organisms!

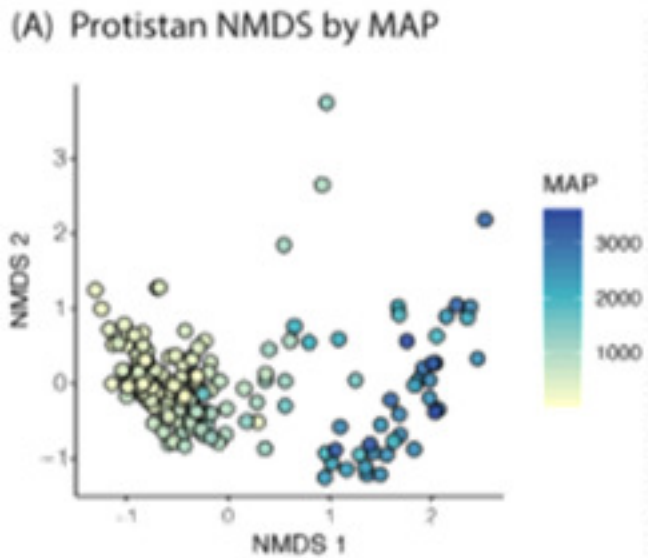


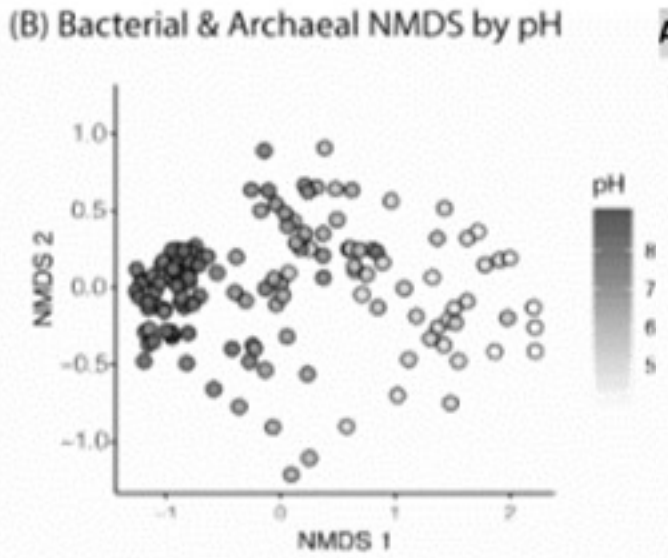
Impressions

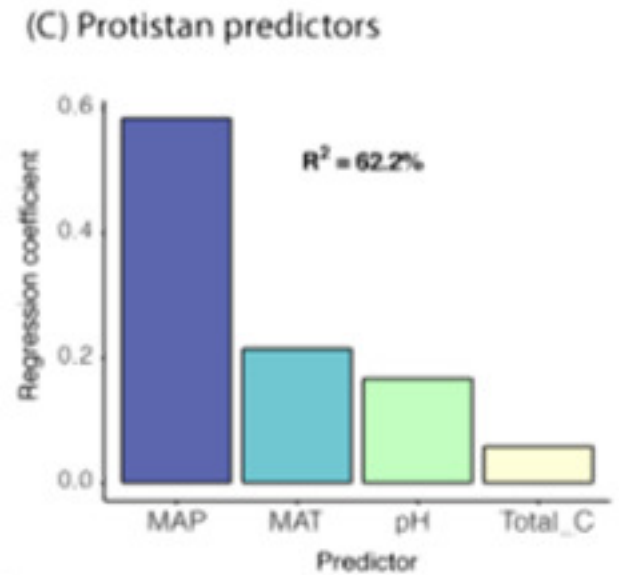


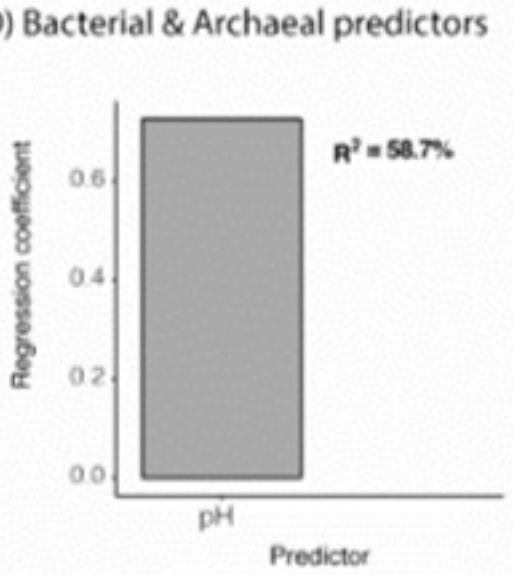
Geisen et al. 2020
Soil Org

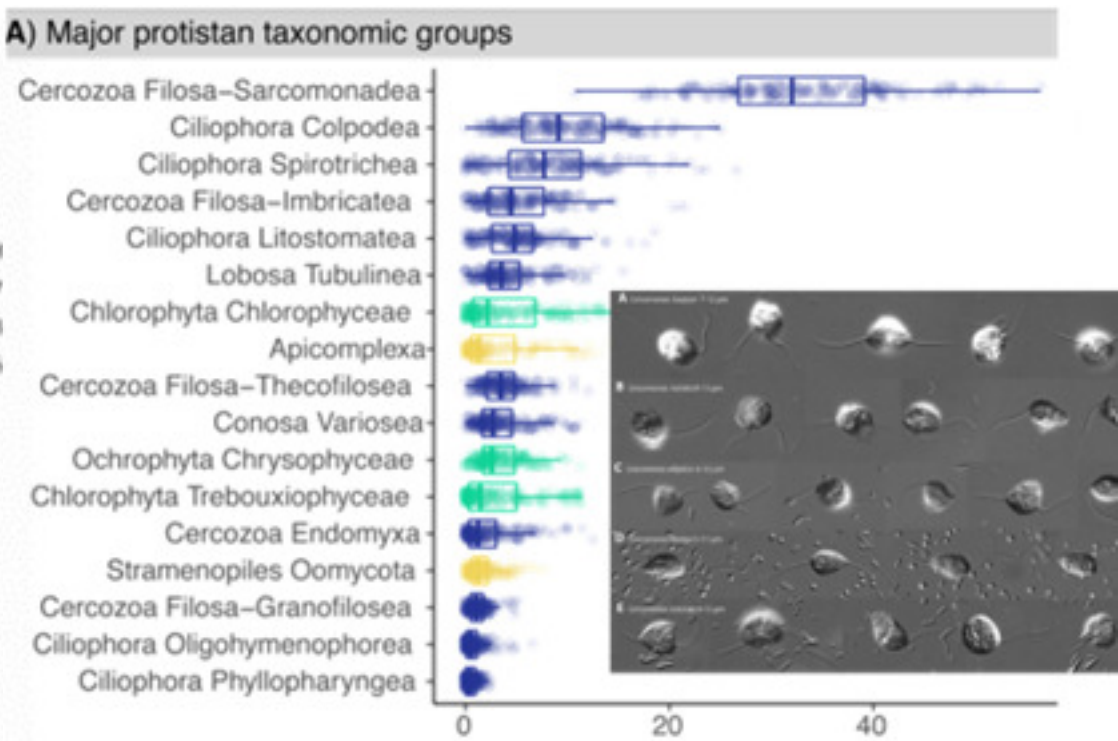
What Determines Soil Protists?







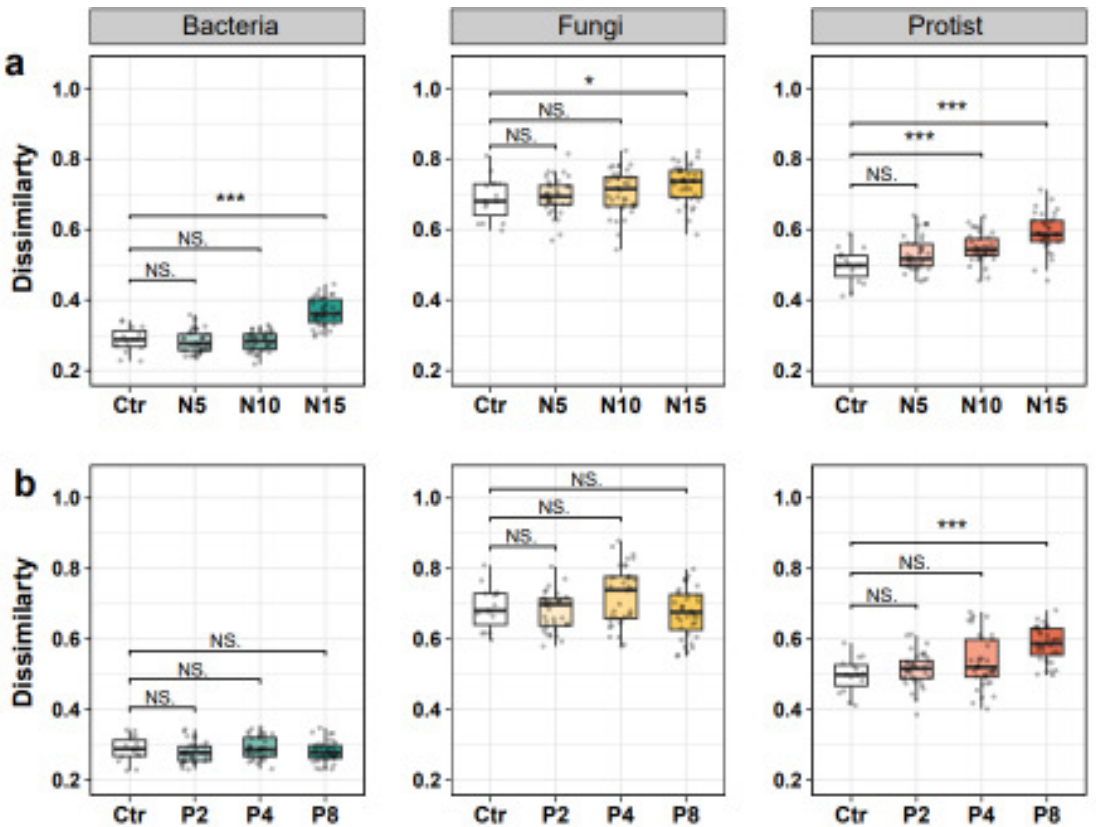




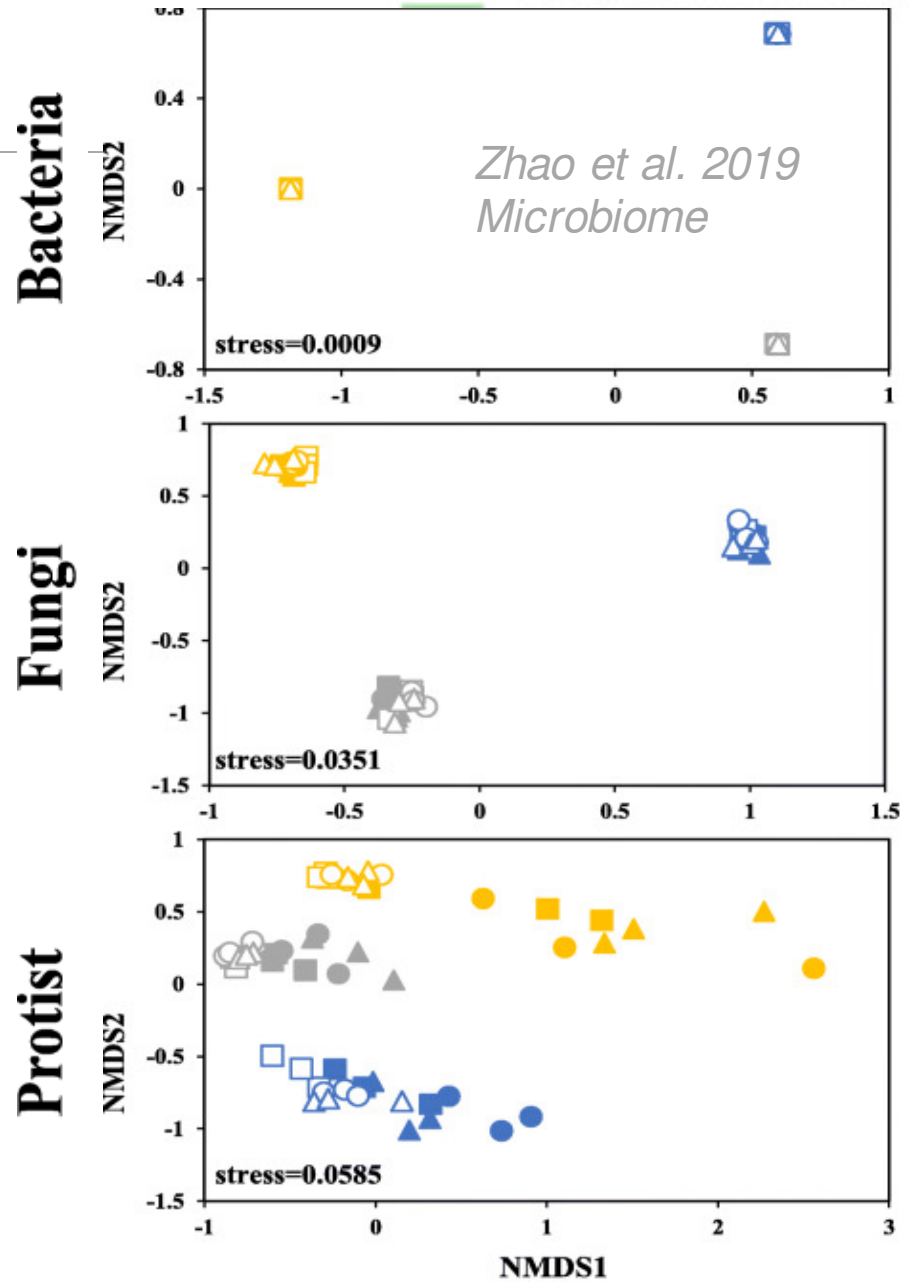
Oliverio, Geisen et al 2020
Science Advances

Protist Traits

- Protist ≠ Protist
- Sensitivity!

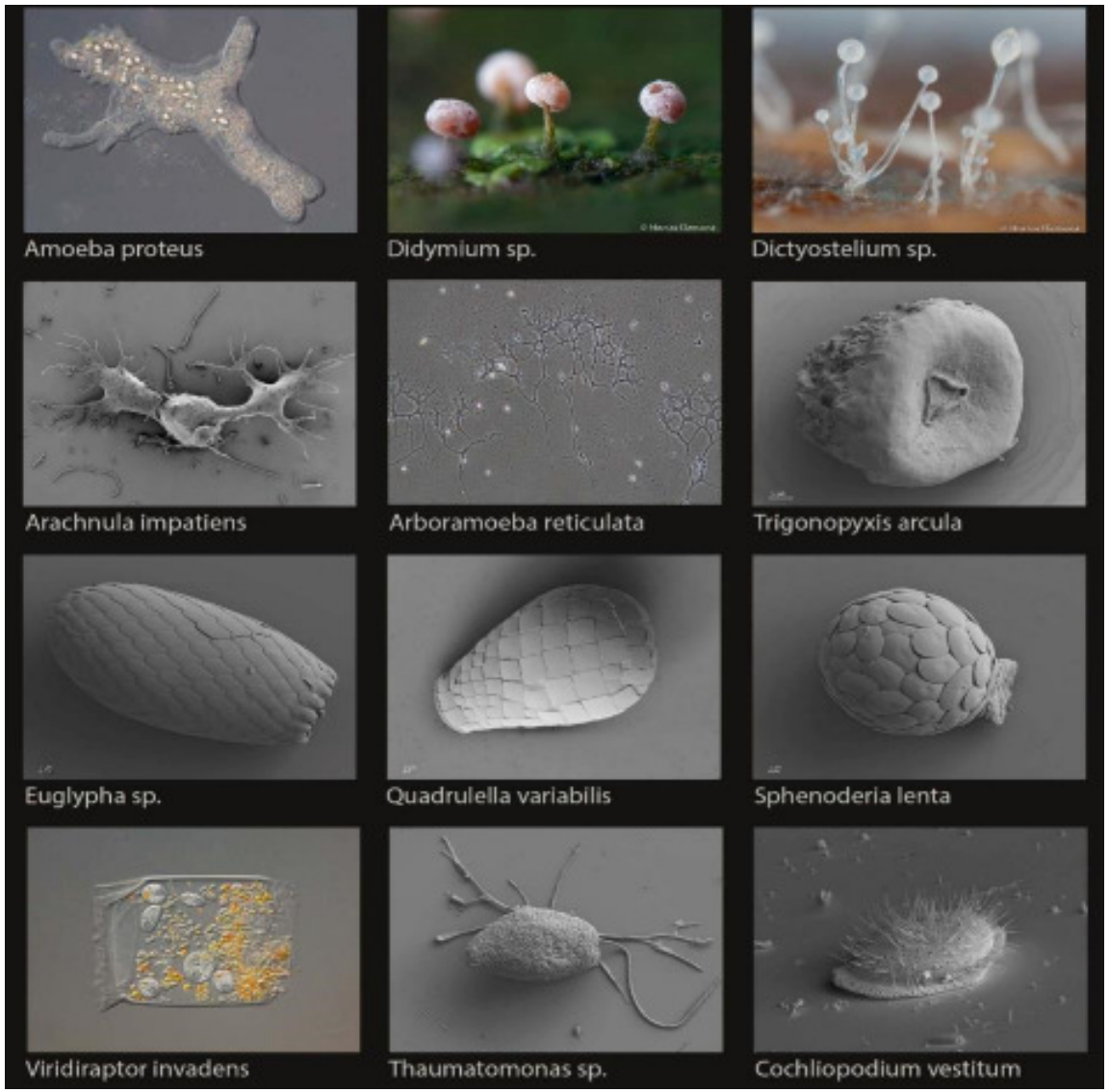


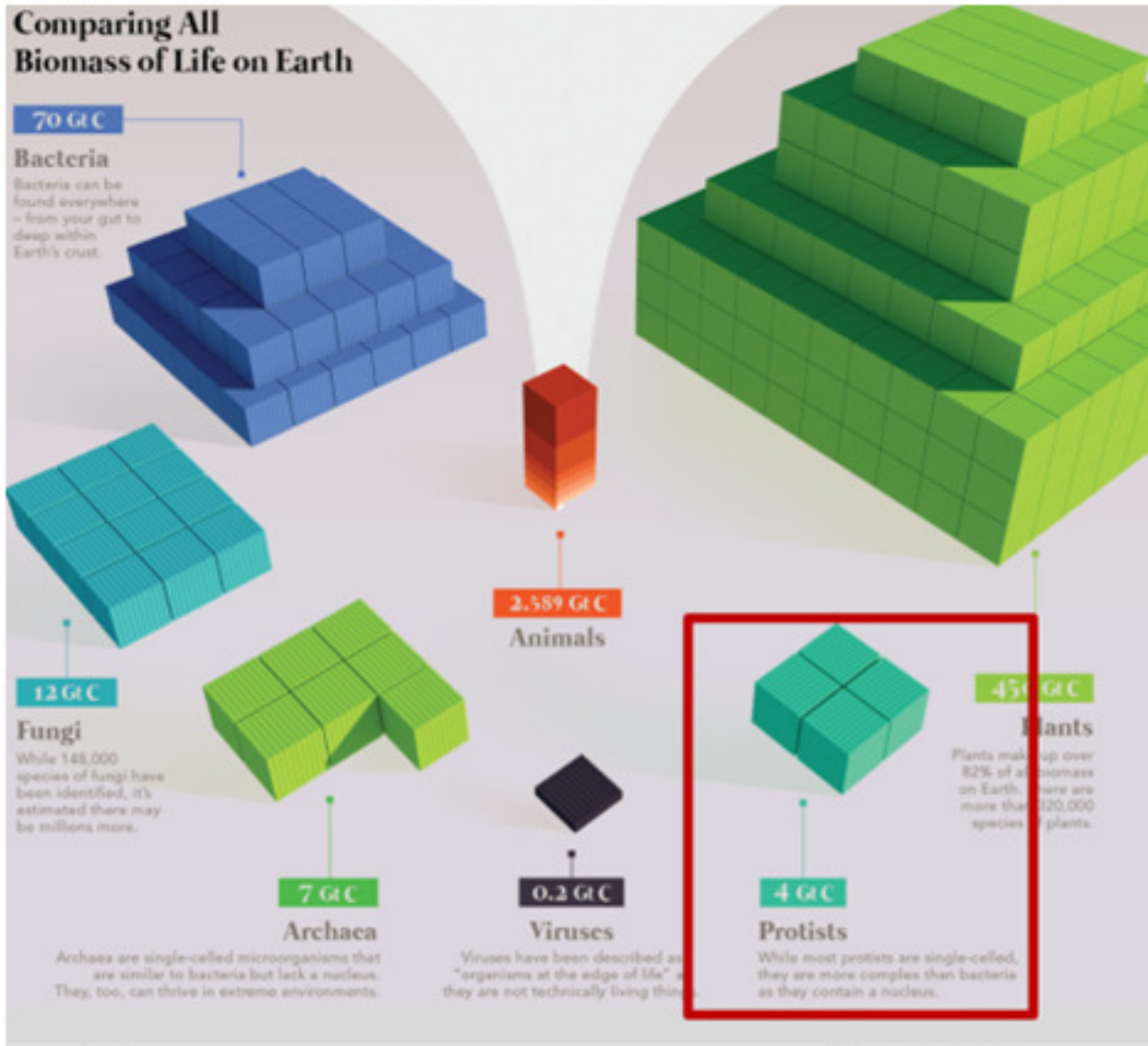
Xiong et al.
In prep



Zhao et al. 2019
Microbiome

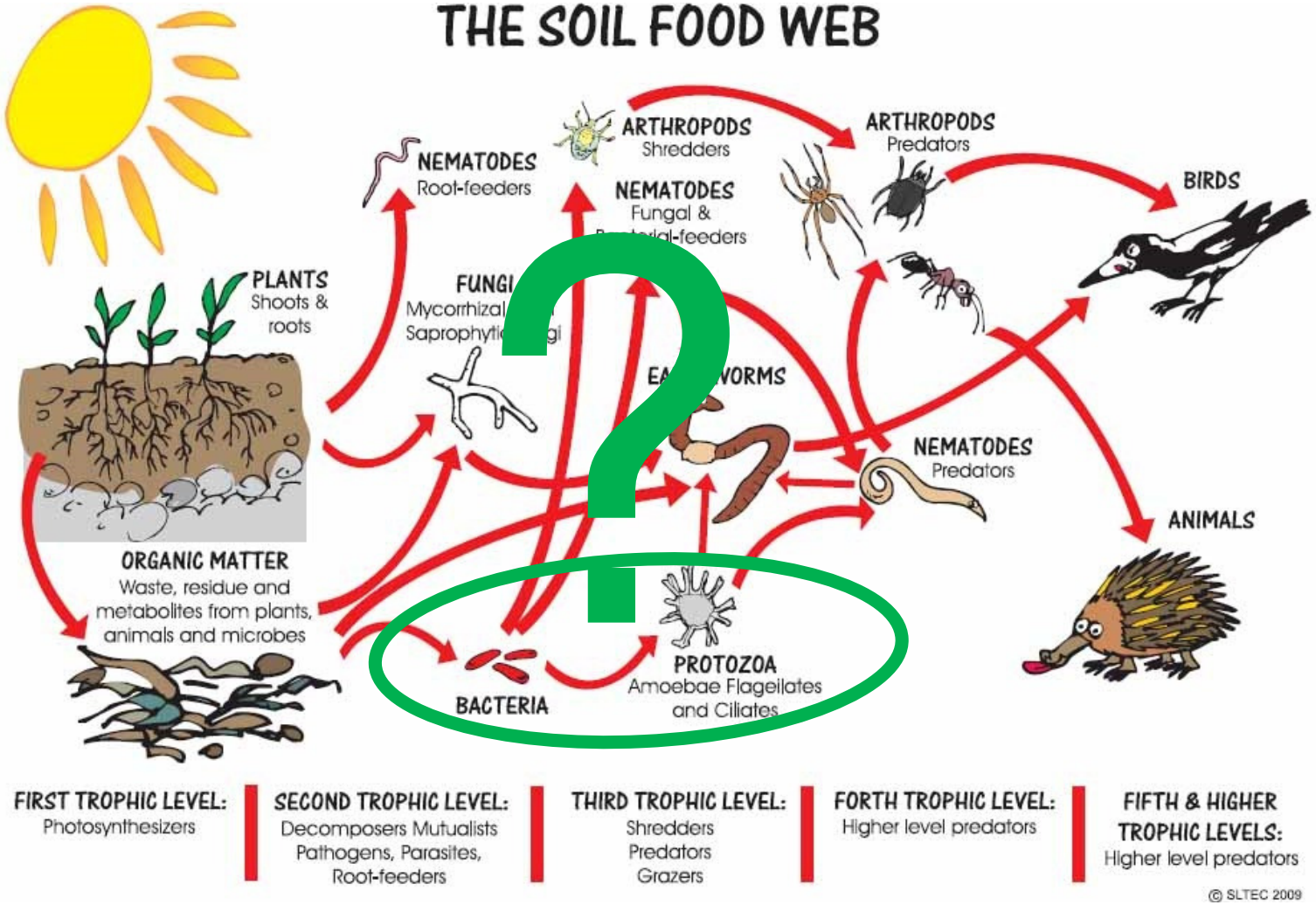
Recap: What are protists?

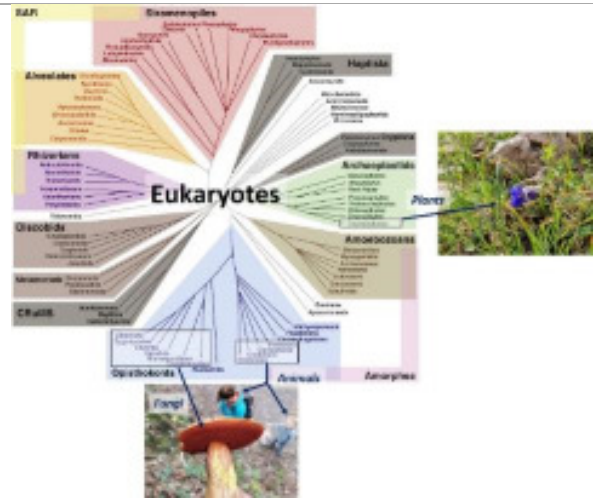




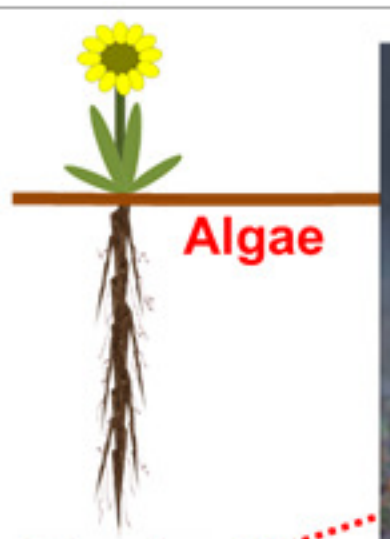
Functions of Soil Protists

Key position in soil food webs as bacterial consumers



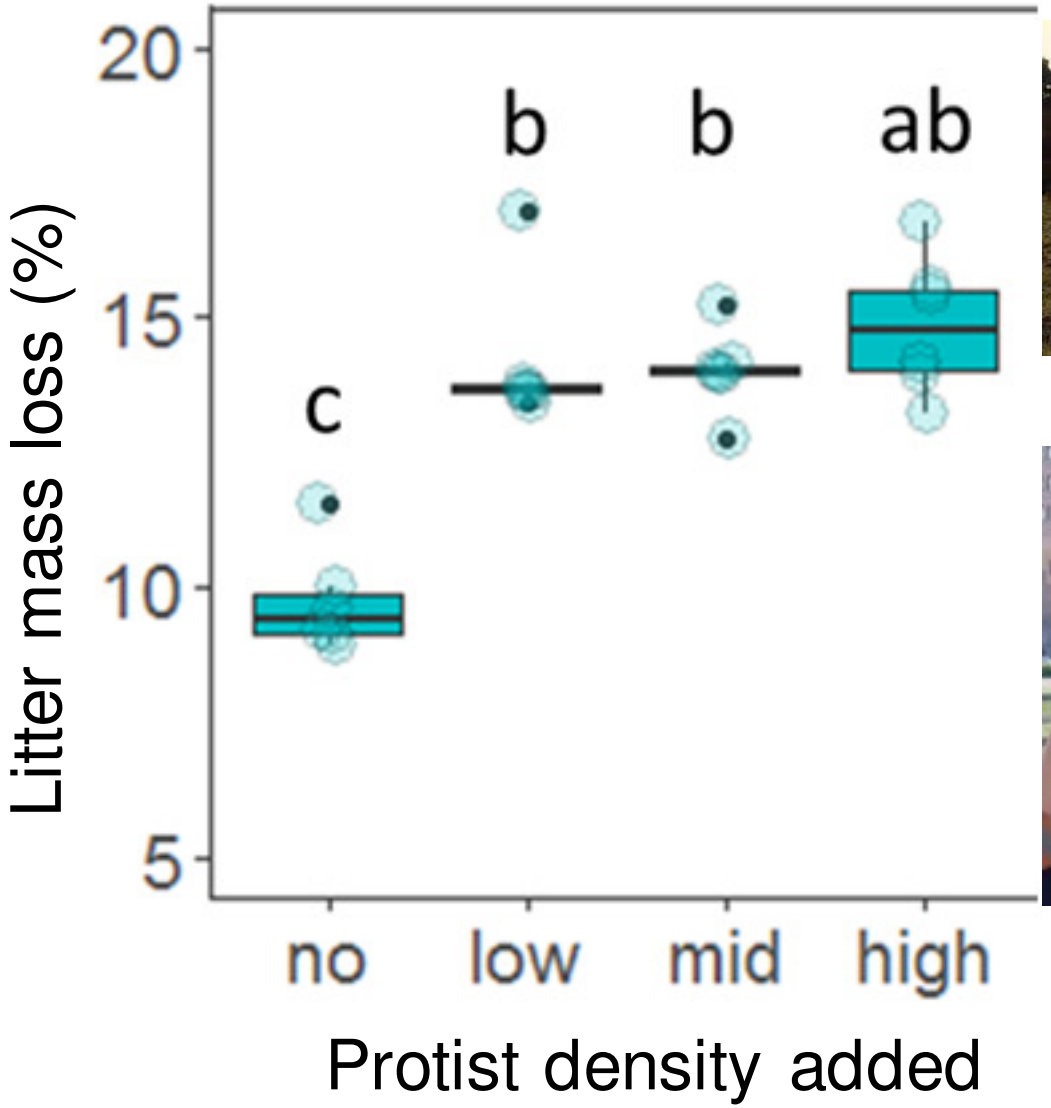


Functions of Soil Protists

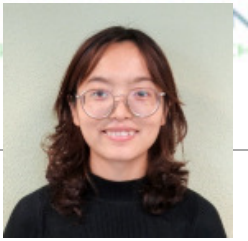


Protists and Decomposition

Geisen et al. ISME 2020

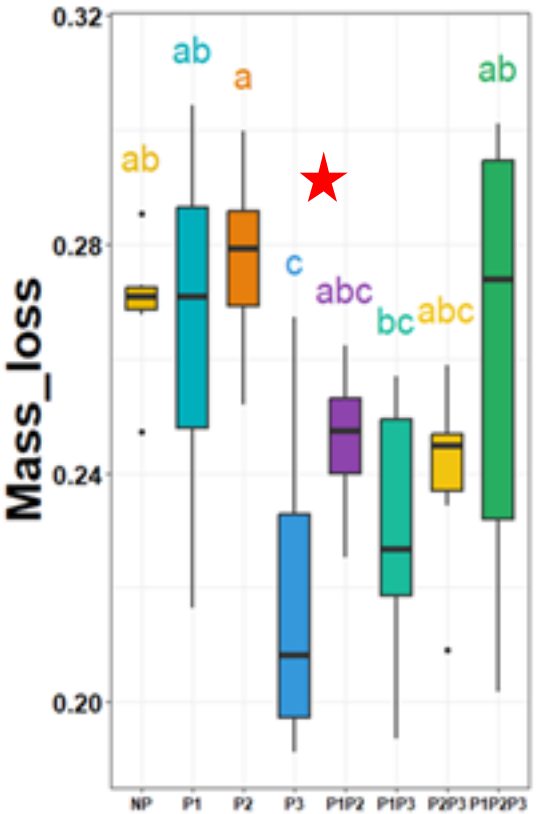


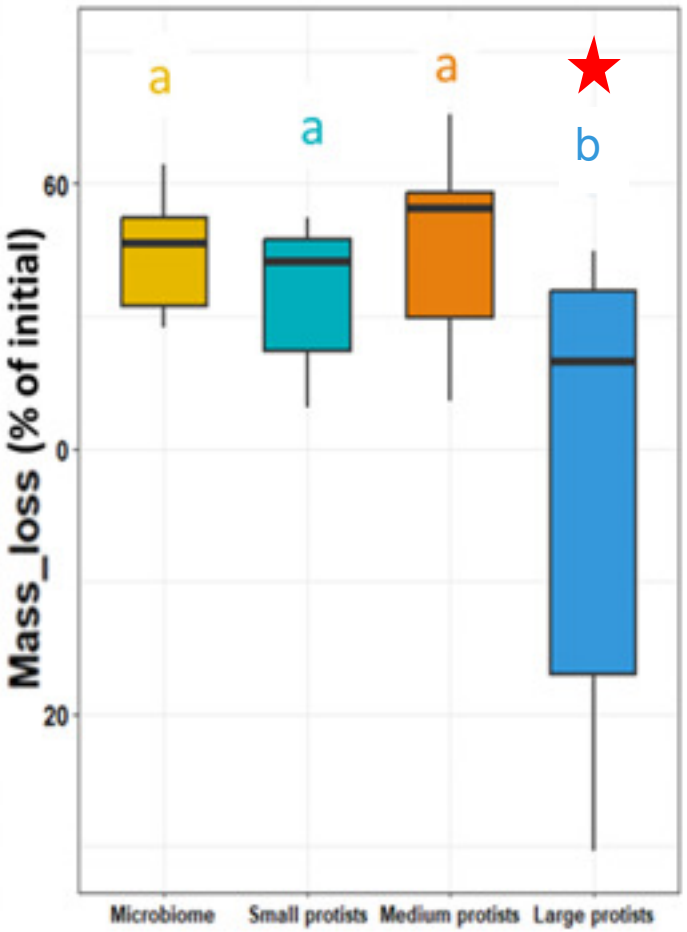
Protist Traits→ Functions

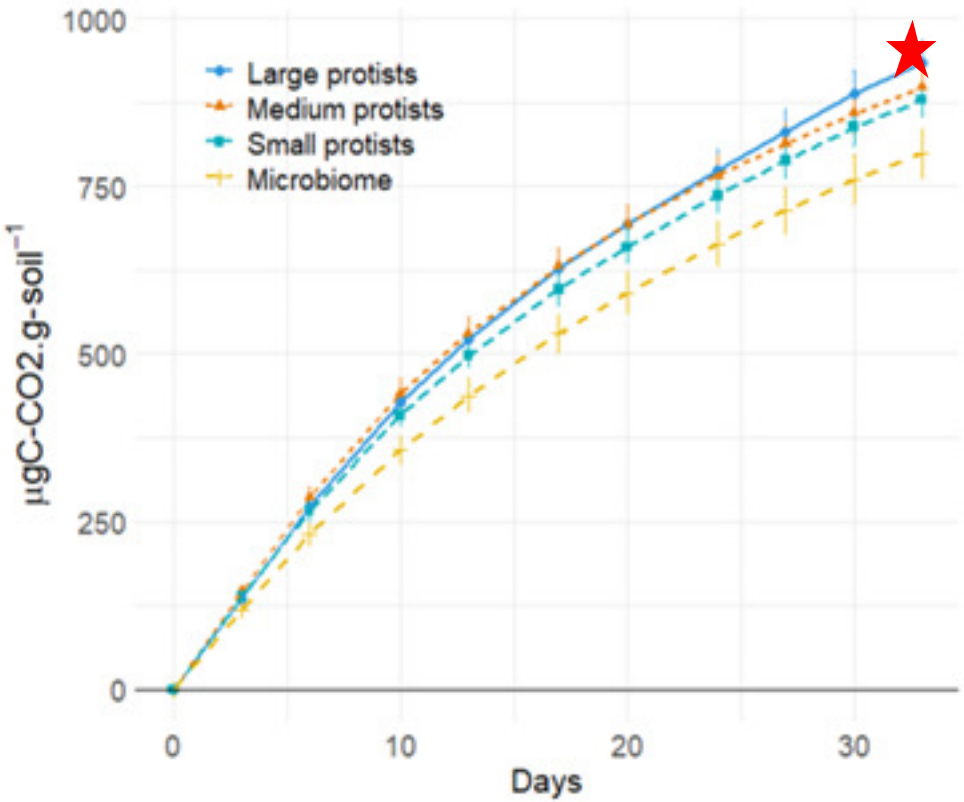


Yuxin Wang

- Protist ≠ Protist

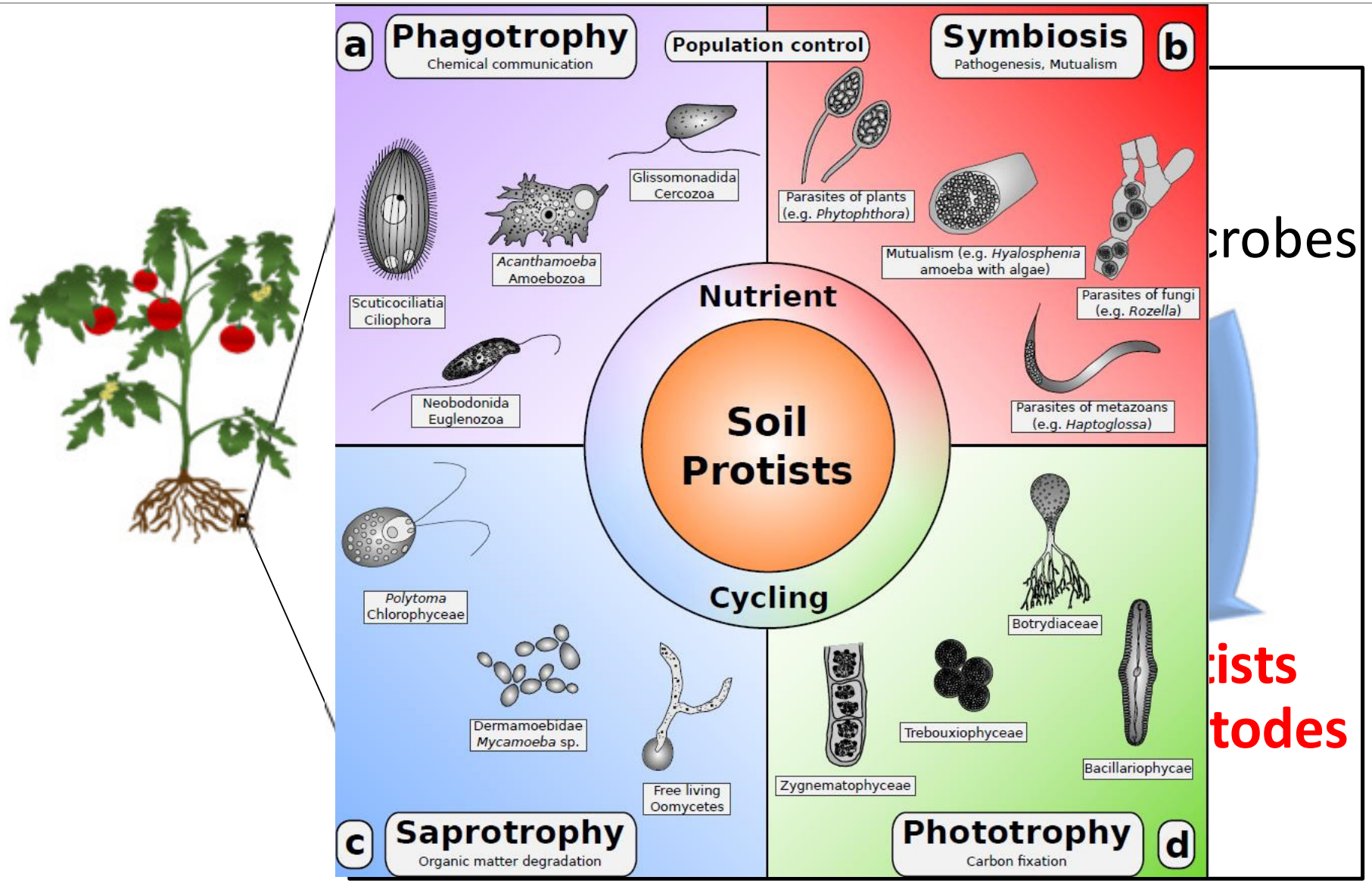




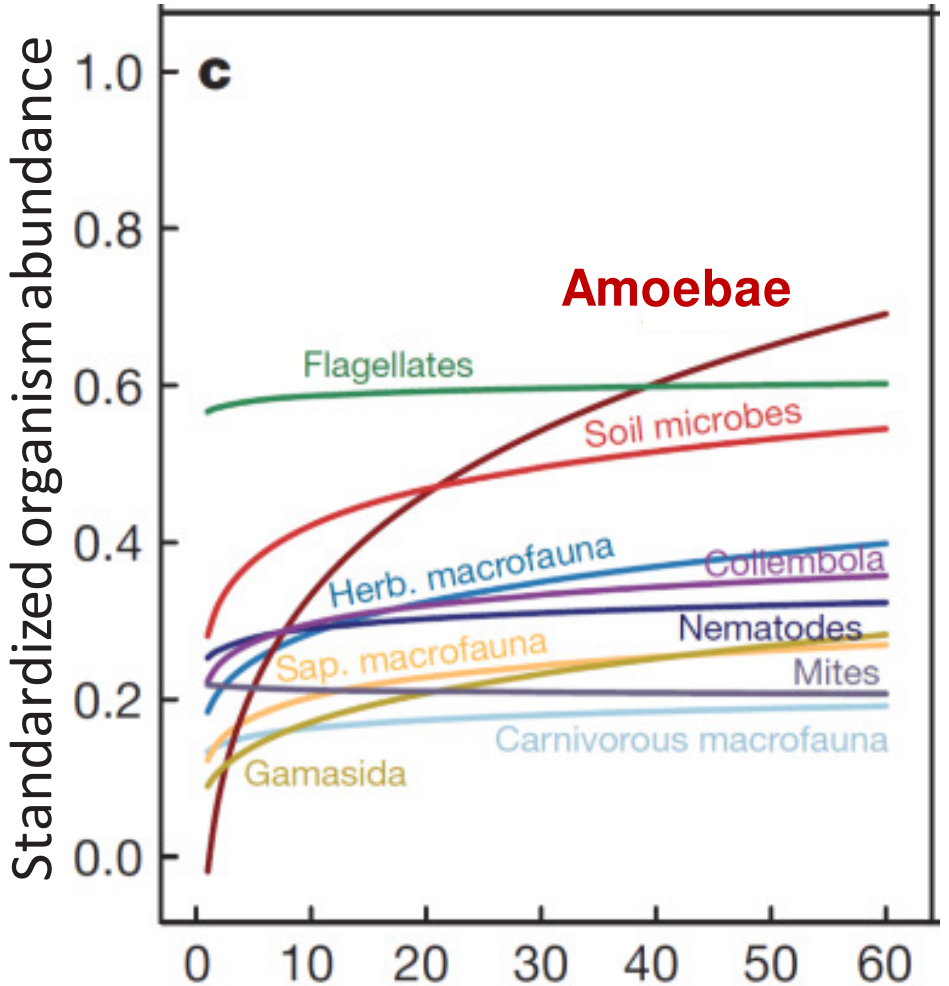


Protists Promote Plants

Protists/Nematodes Promote Plant Performance



Plants Promote Protists



Scherber et al. 2010 Nature

Protists & Plant Yield

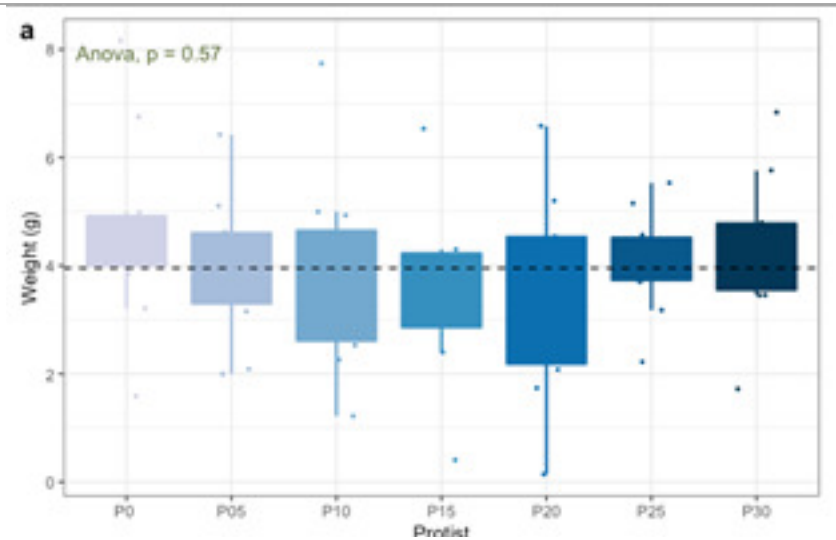
Guo, Xiong et al. 2021 Microbiome

pt 2024

Protists as Models for Global Change Research

Berlinches de Gea et al 2023 SBB

Protist diversity can matter

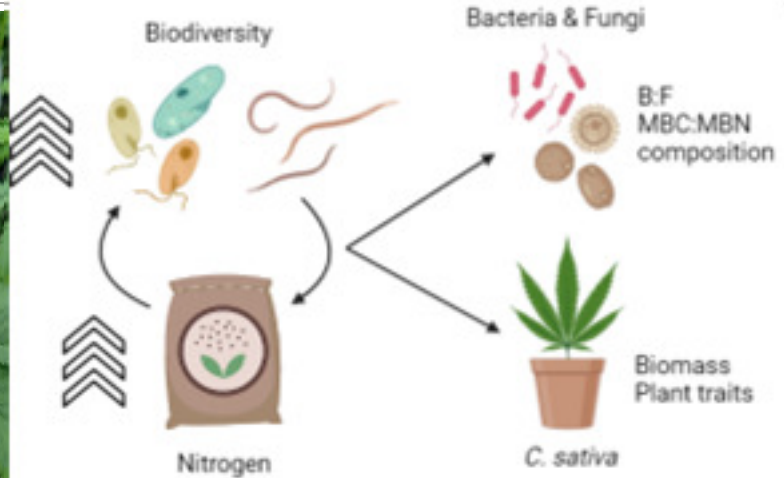


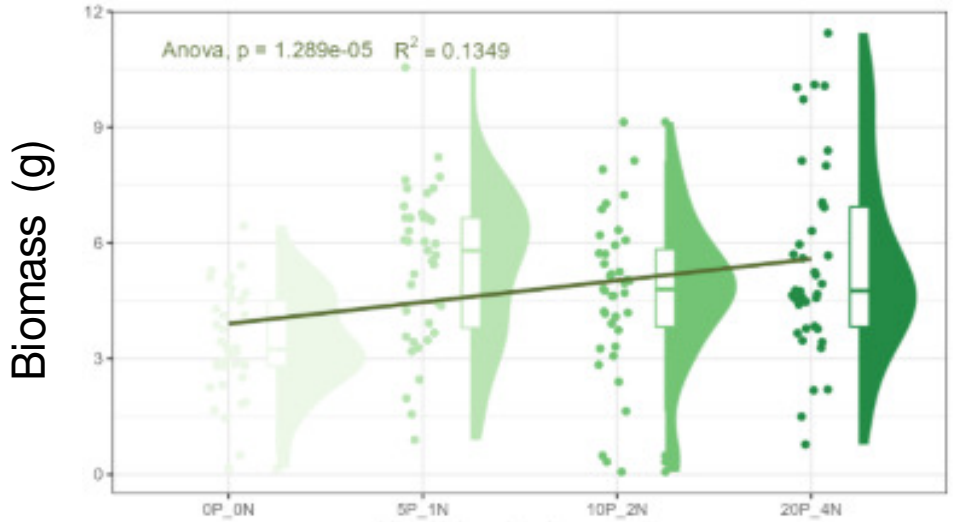
Shoot biomass

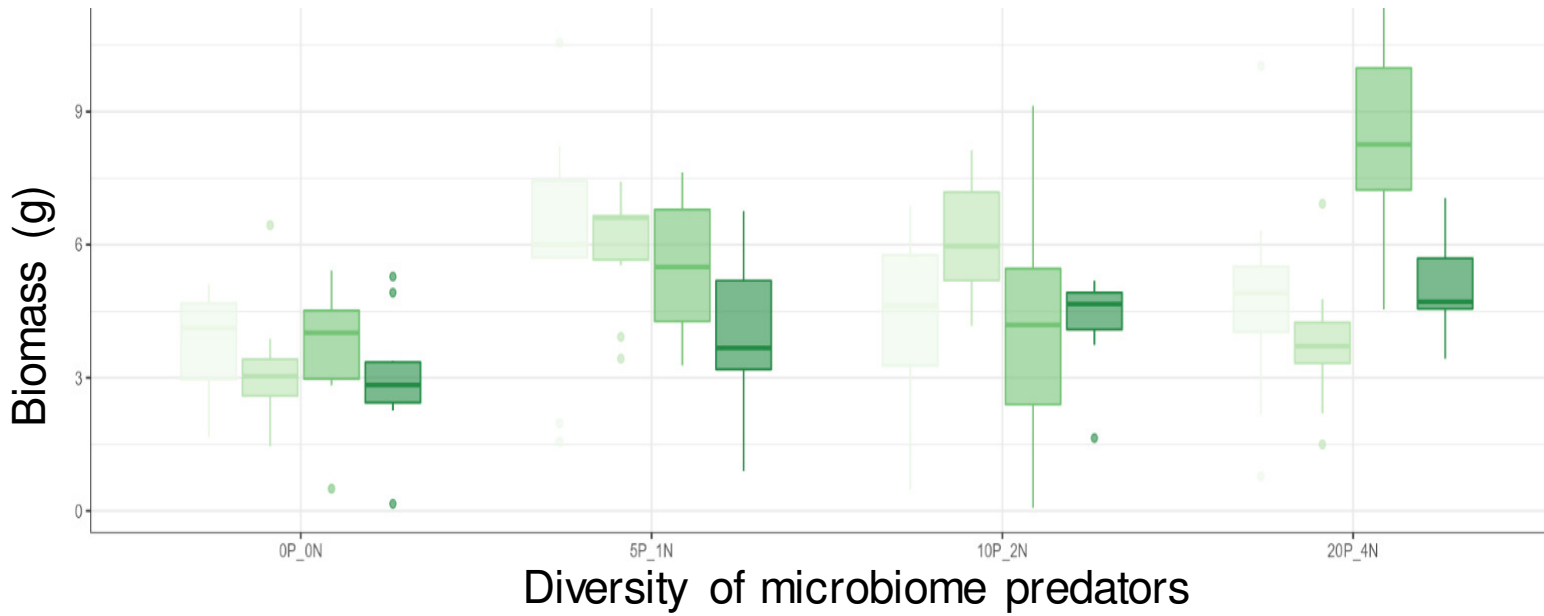
Protist diversity

Berlinches de Gea et al 2023 SBB

Protists: Chance for N Reduction?

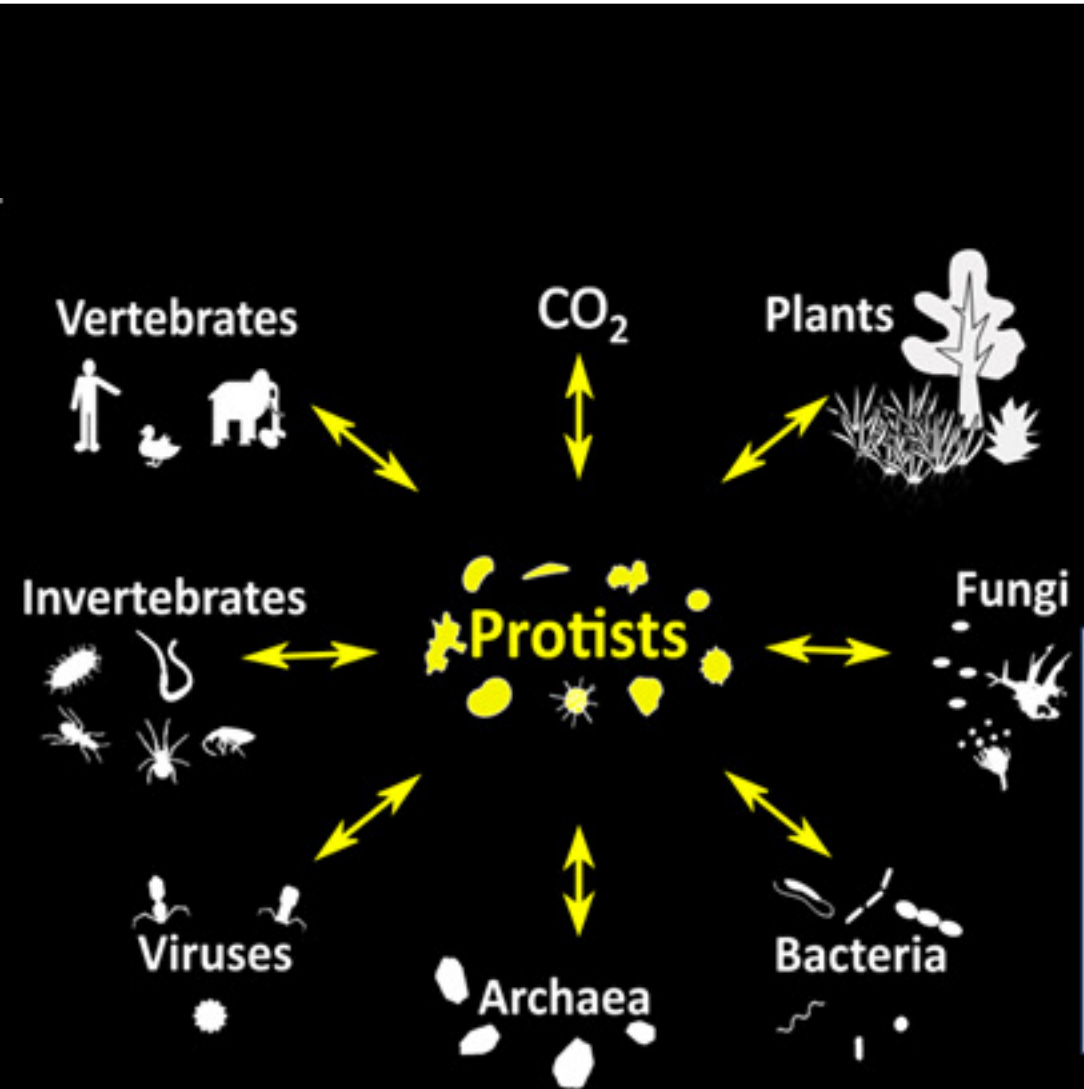


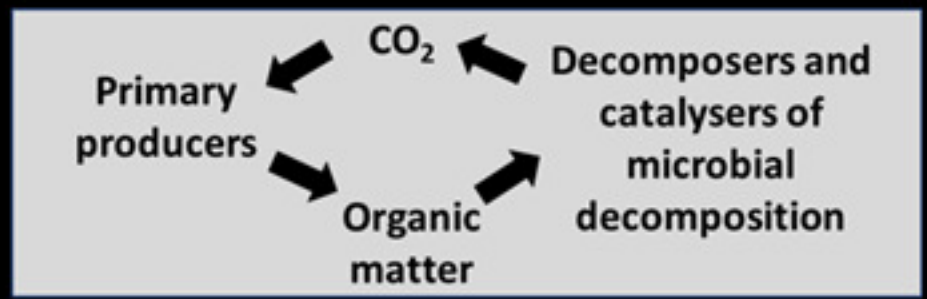




Soil Protists in Application

Protists: What they do





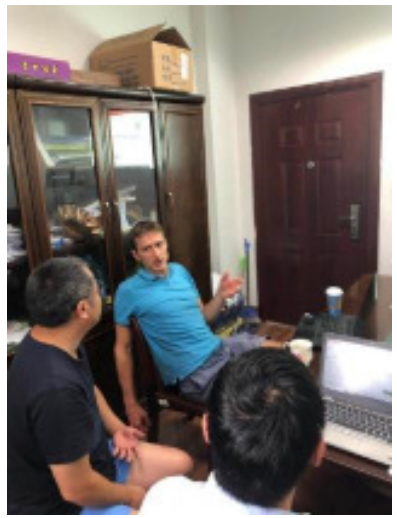
Controllers (+/-)	Controlled by (-/+)	Mutualists (+/+)
Consumers of: Bacteria, Archaea, Fungi, Protists and Animals **Parasites** of: Fungi, Protists and Animals **Pathogens** of: Plants	**Hosts** of: Viruses, Bacteria, Protists and Fungi **Prey** for: Fungi, Protists and Animals	**Mutualists** with: Bacteria, Animals, Protists and Plants

Geisen et al. (2020) Soil Organisms

Summary

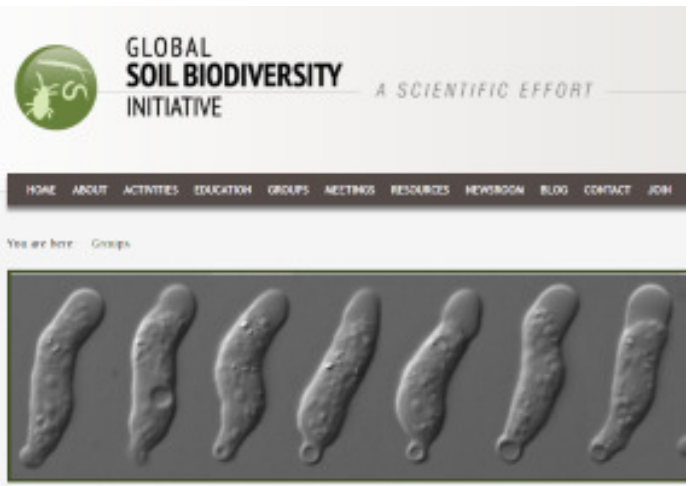
- Soil (microbial) biodiversity pivotal for planet´s health
- Protists taxonomically and functionally diverse
- Protists key for soil/plant functioning

FUN!



- Many open questions and potentials
- Growing interest in Science & More (Publications, proposals, consortia…)

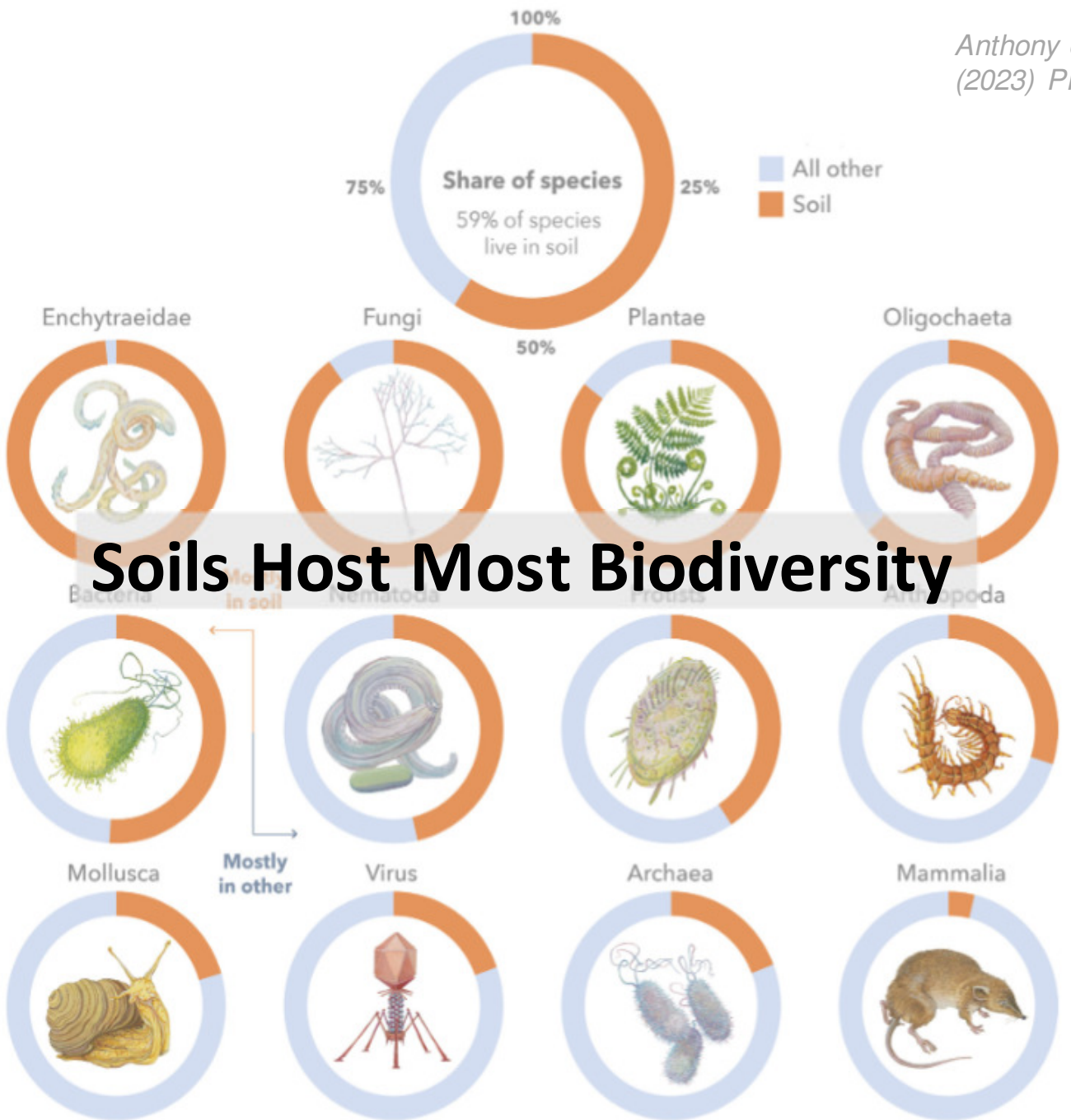
*Next steps – **Biodiversity???***




Why is there so much
Biodiversity?

Hutchinson 1961: Paradox of the plankton

Soils Host Most Biodiversity



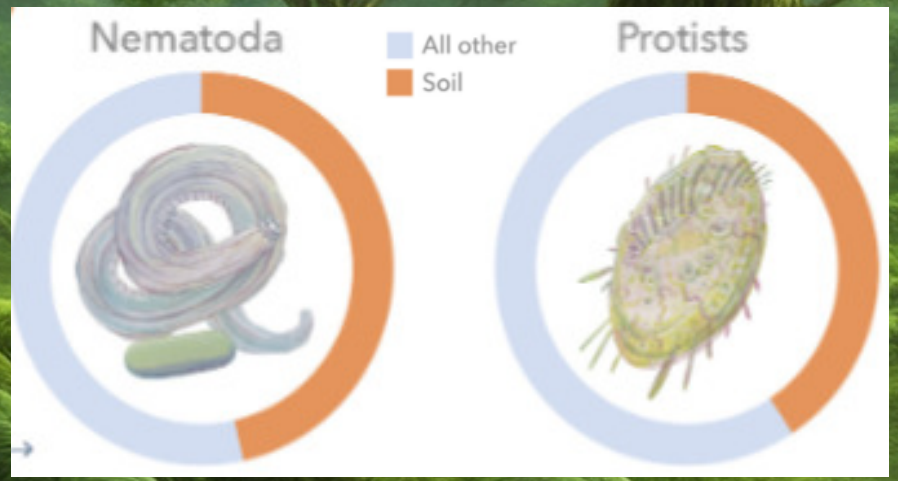
Anthony et al. (2023) PNAS

Anderson 1975: Enigma of Soil Animal Biodiversity

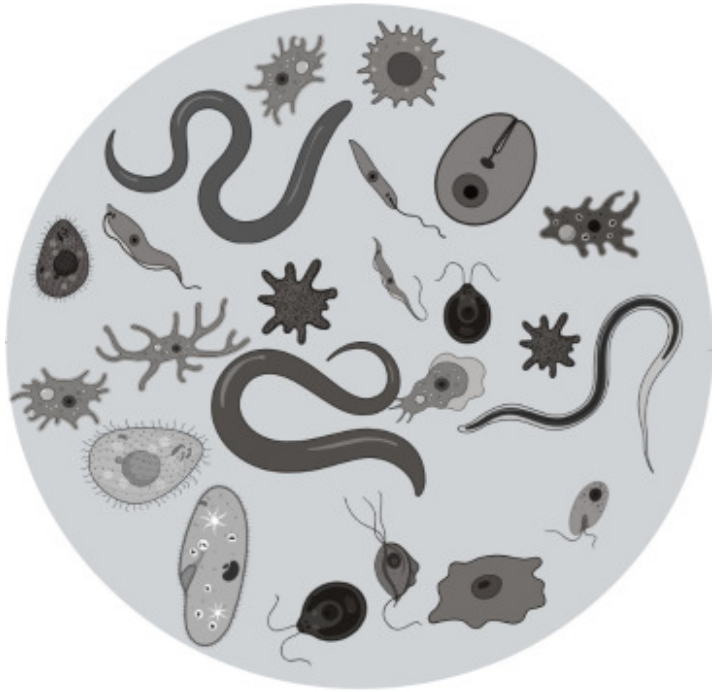
Nematodes

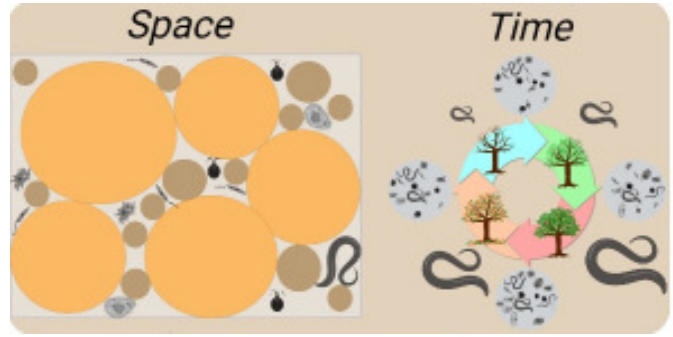
?

Green World Hypothesis

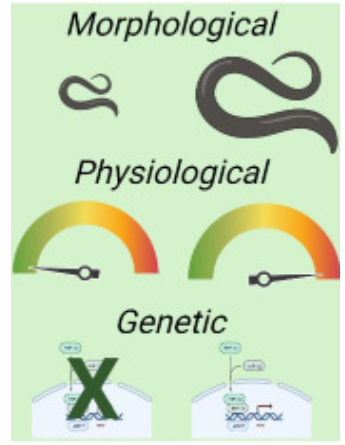


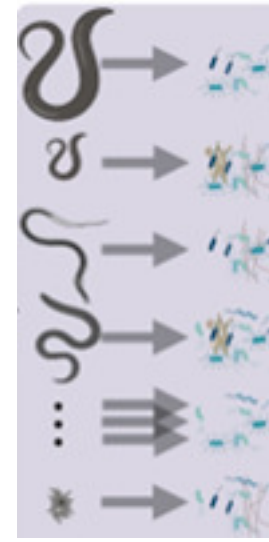
Protists

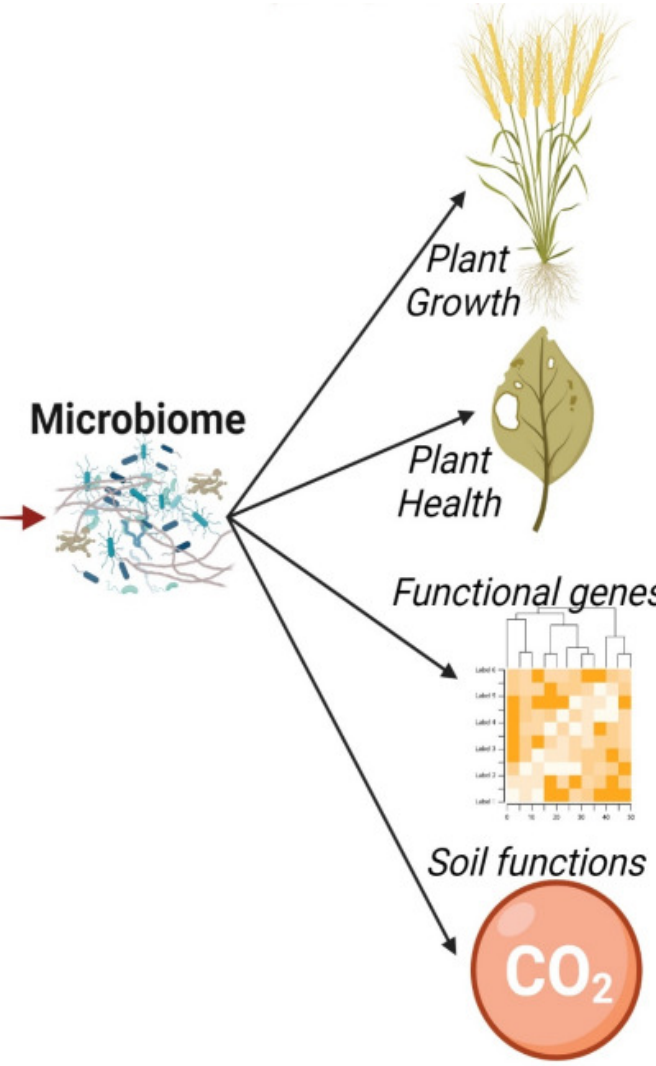




Proposed Work

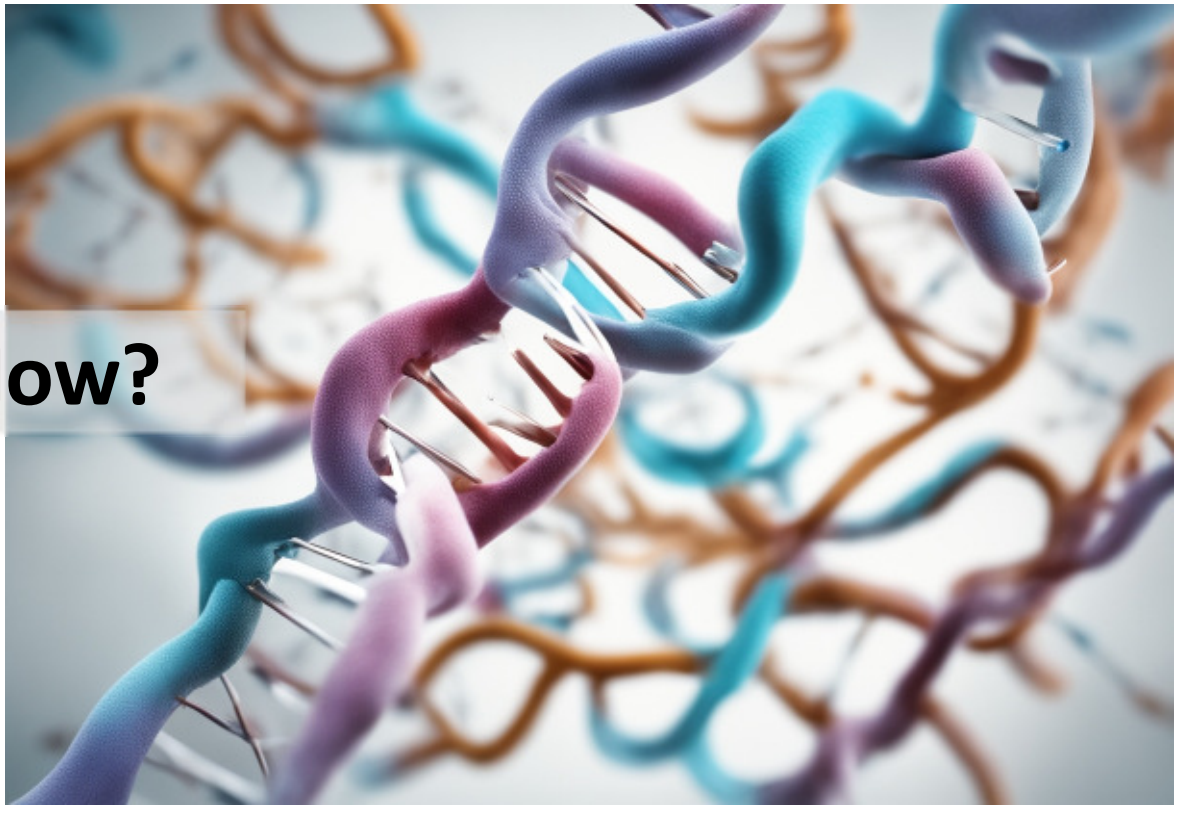






Real Biodiversity ***Underlying Reasons*** ***Functional Impact***

Why Now?



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Council of the EU | Press release | 17 June 2024 13:45

Soil monitoring law: EU on the pathway to healthy soils by 2050


IMPACT
Understanding Mechanisms of Soil Microbiome Predator Diversity
➢Predict & Create Biodiverse Soils

Farmhealth

We will make it!

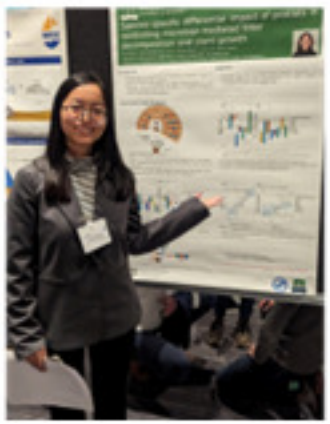
Anthelminthics

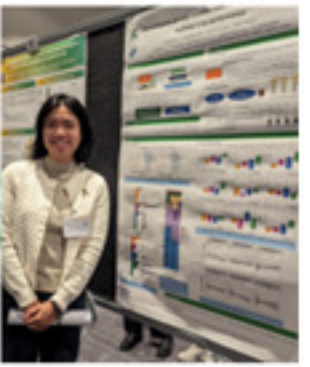
EGOTIST

BIOSERVICES

MINAGRIS

Eleni Lamprou



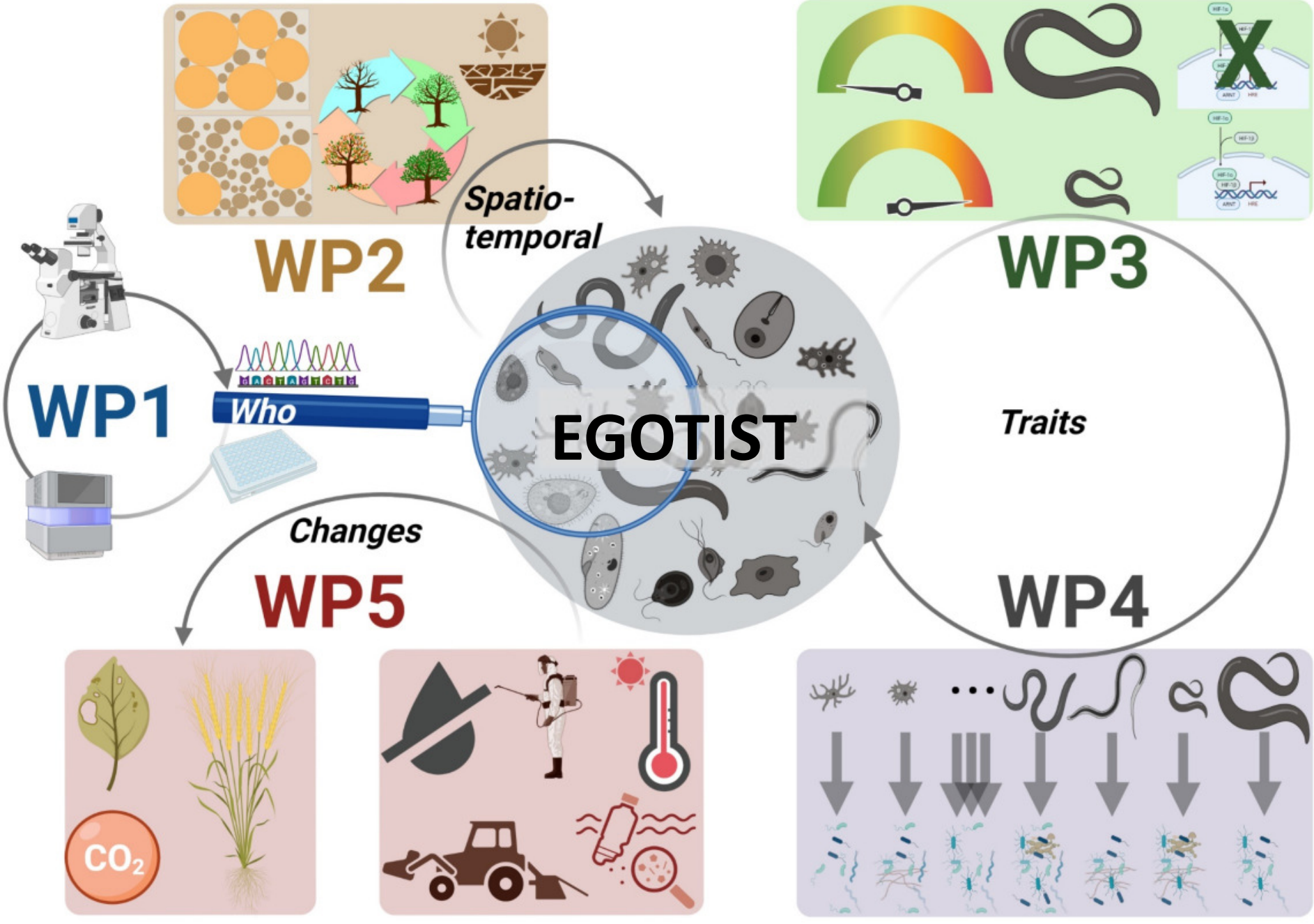


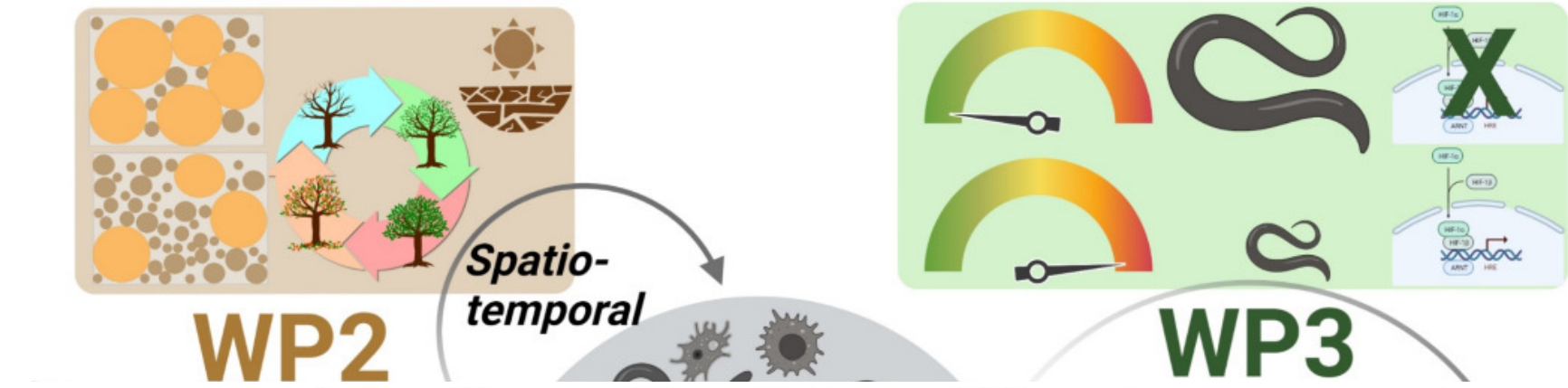
Acknowledgements

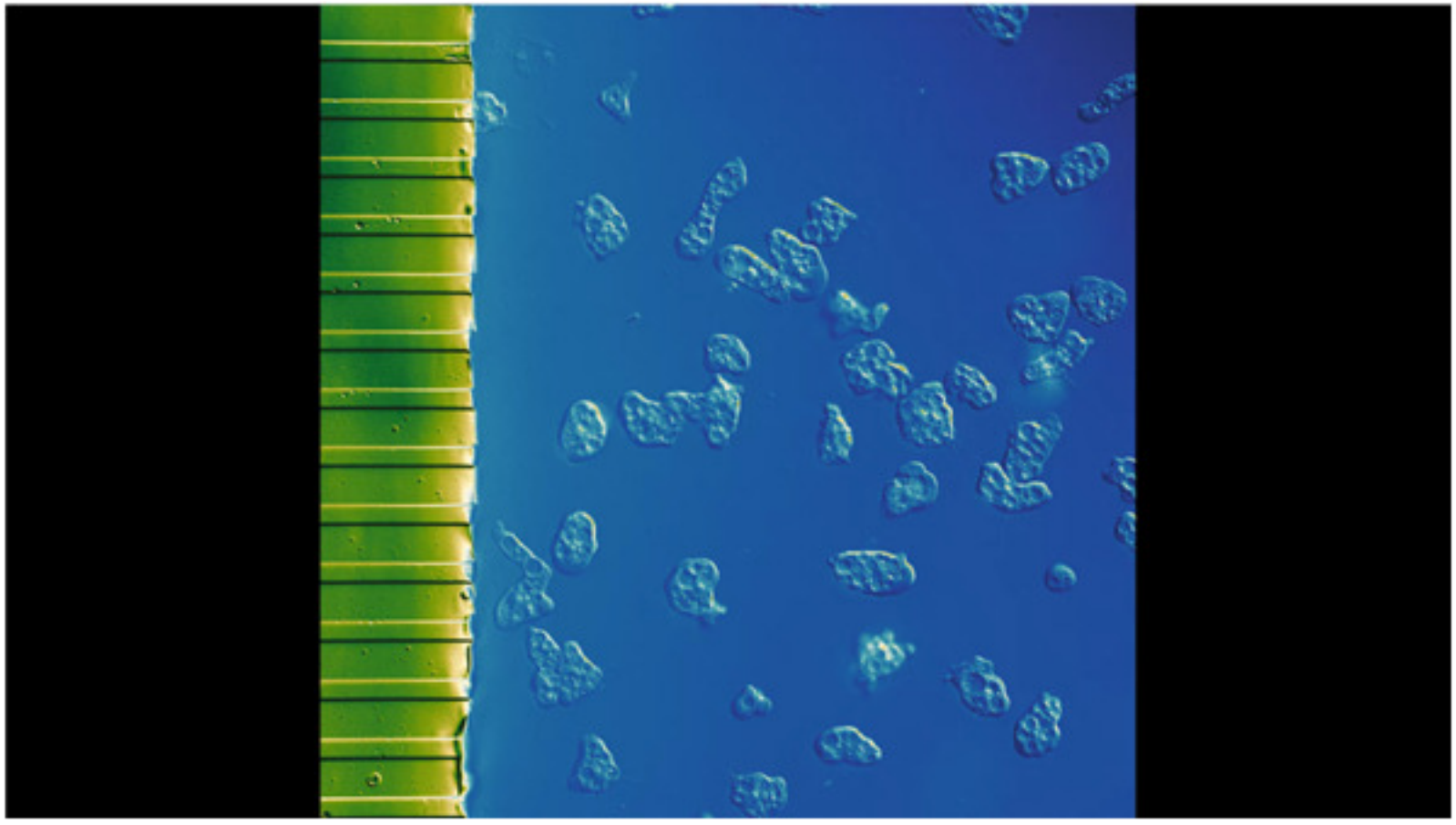
- Wageningen University & Netherlands Institute of Ecology (NIOO-KNAW)
  - Alejandro Berlinches de Gea, Guixin Li, Arne Schwelm, Yuxin Wang, Shunran Hu, Rutger Wilschut...
  - Wim van der Putten, Ciska Veen...
- Global Soil Biodiversity Initiative (especially Diana Wall)

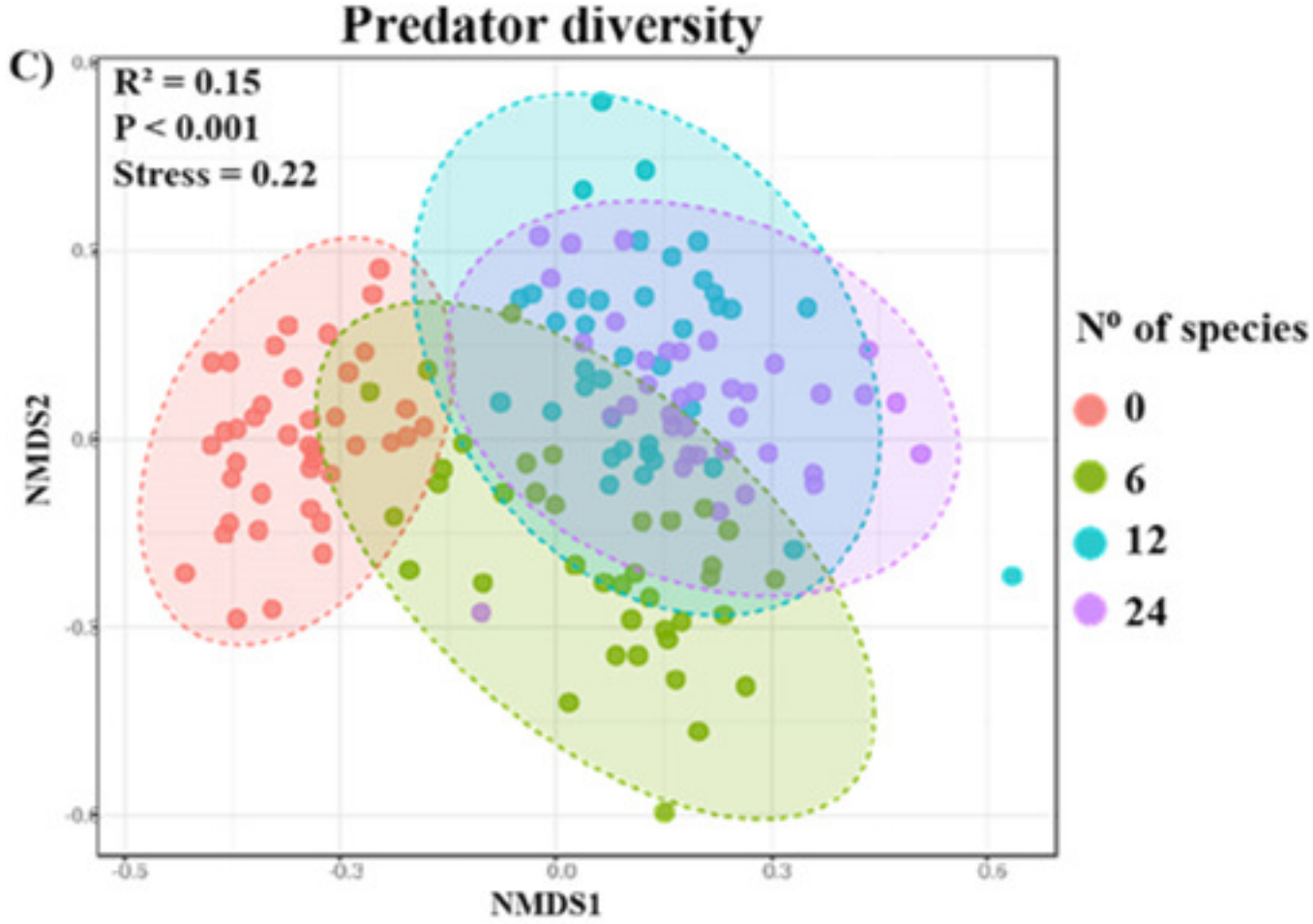
- Nanjing Agricultural University
  - Rong Li, Qirong Shen, Xiong Wu, Sai Guo

YOU!!!

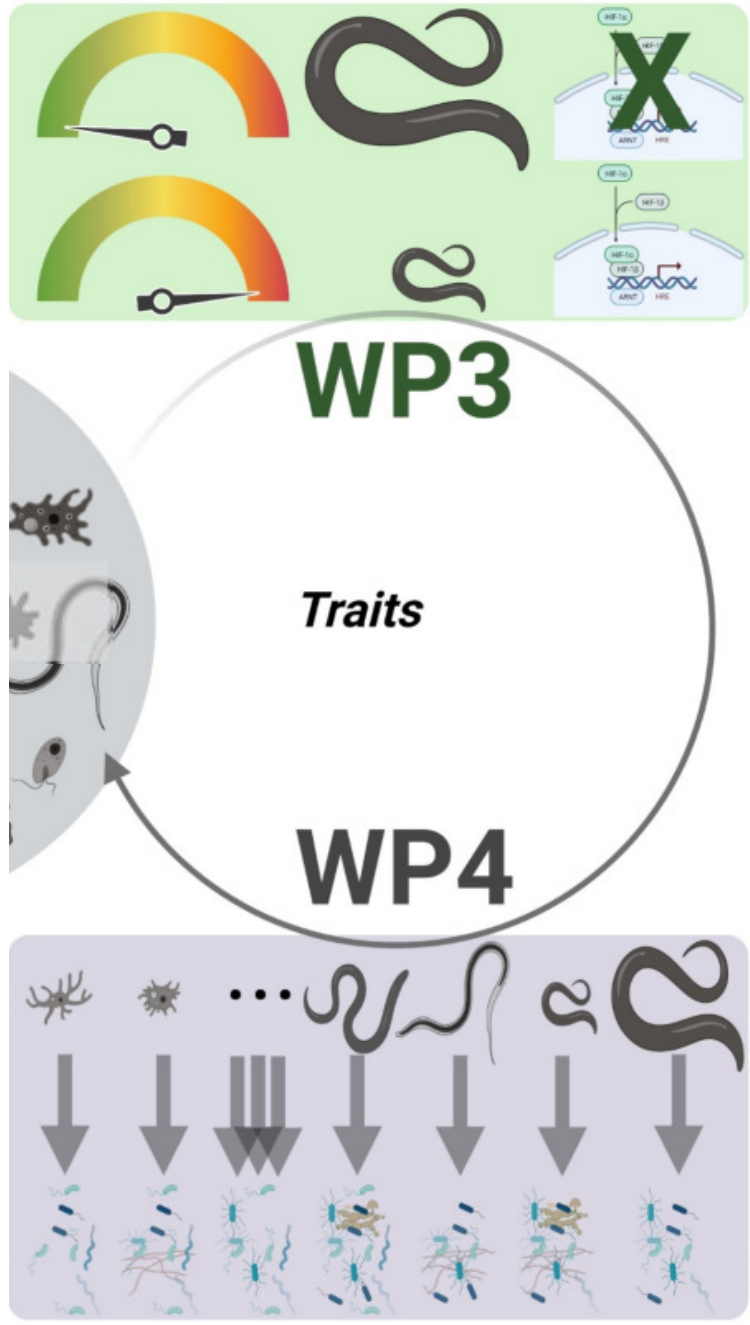

WP2
Spatio-
temporal
WP3
WP1
Who
EGOTIST
Traits
Changes
WP5
WP4
CO_2

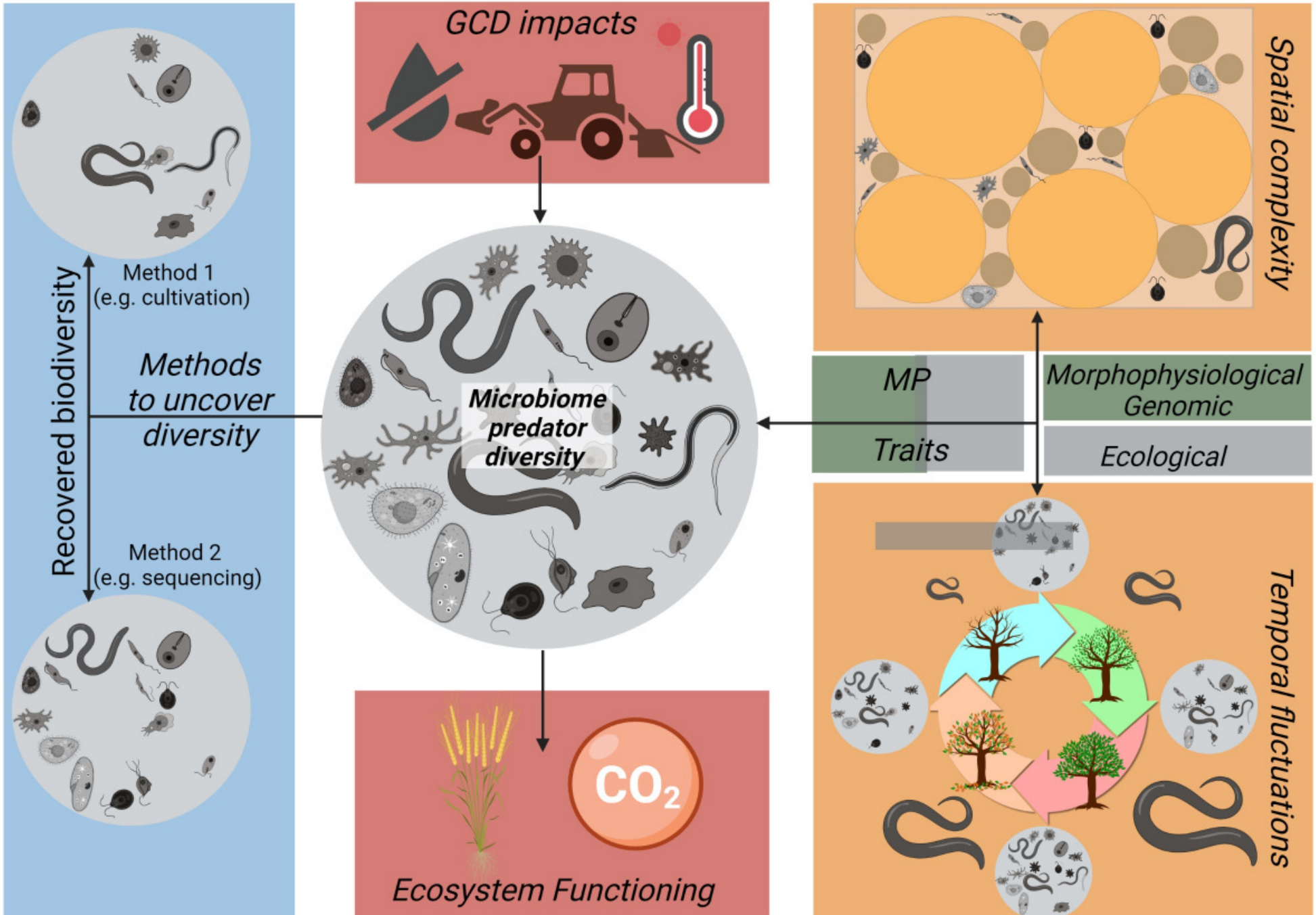

Spatio-
temporal
WP2
WP3

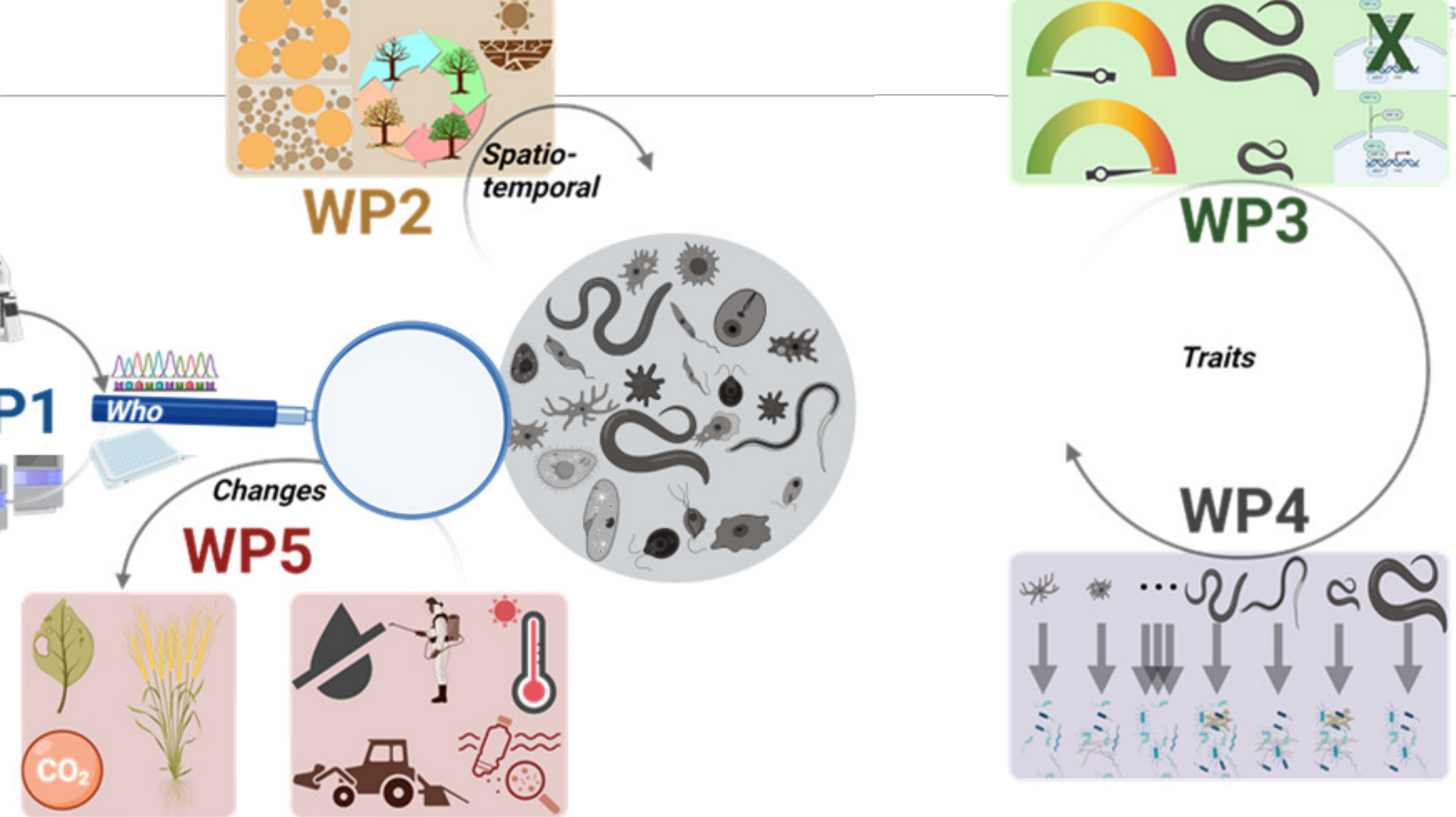




Preliminary data




GCD impacts
Spatial complexity
Method 1
(e.g. cultivation)
Methods
to uncover
diversity
Recovered biodiversity
Method 2
(e.g. sequencing)
Microbiome
predator
diversity
MP
Traits
Morphophysiological
Genomic
Ecological
Temporal fluctuations
CO2
Ecosystem Functioning


WP2
Spatio-
temporal
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Traits
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P1
Who
Changes
WP5
CO_2