

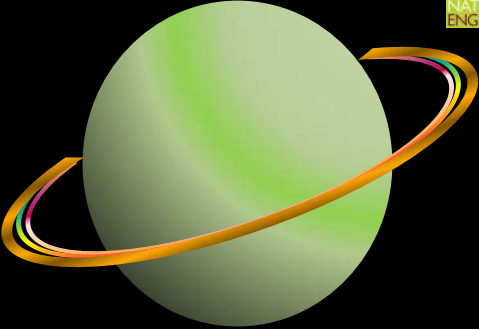


How Farmers Can Save the Planet

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Soil Biodiversity Specialist, Natural England

EARTH IS BEING INVADED BY ALIENS FROM PLANET ZARG!







NATURAL
ENGLAND

MISSION:

- IDENTIFY SUPERIOR SPECIES
- LOCATE LEADER
- NEGOTIATE INSTANT SURRENDER

Earth or bust!

SUPERIOR SPECIES WILL:

- BE NUMEROUS
- LIVE IN LARGE COLONIES
- BE LIKE THE ZARGIANS



30
cm
tall

Aggressive attitude

Useful upper limbs

Bipedal gait

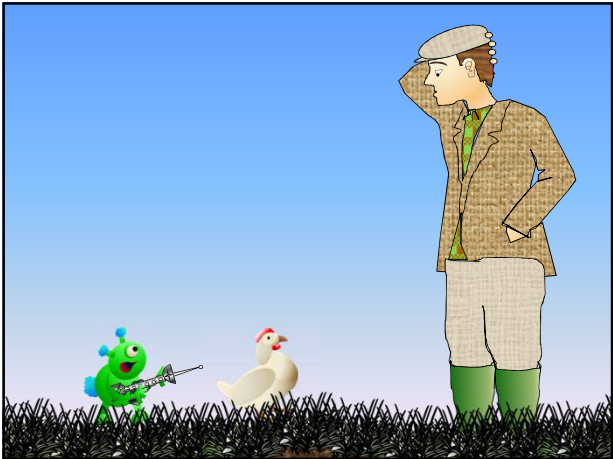
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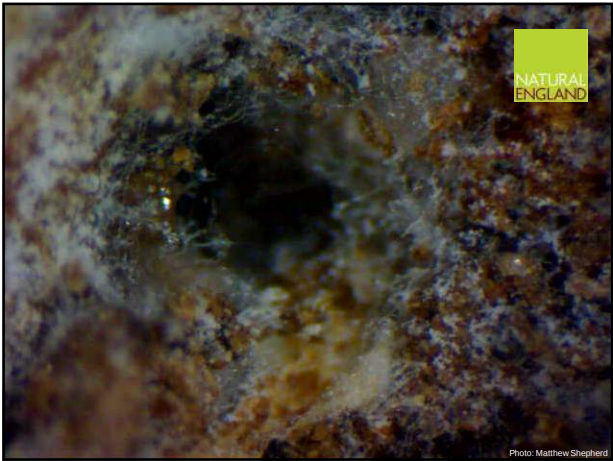


TAKE ME TO
YOUR LEADER!

what the
cluck?

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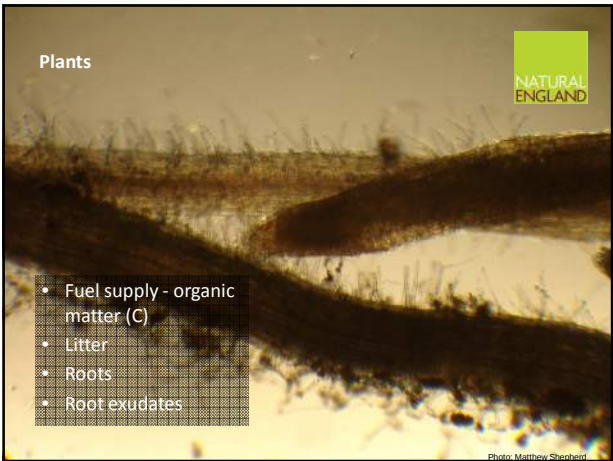


Photo: Matthew Shepherd

Bacteria

- Chemical factories
- Fixing and tranforming N
- Decomposing and release nutrients

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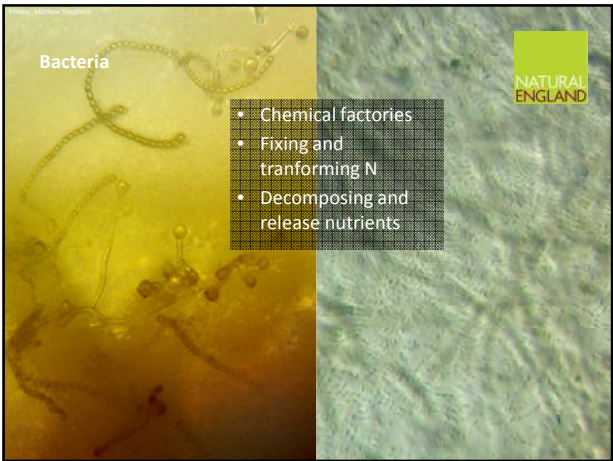


Photo: Matthew Shepherd

Fungi and mycorrhizas

- Vast networks of tubes
- Also great decomposers
- Link up with plants

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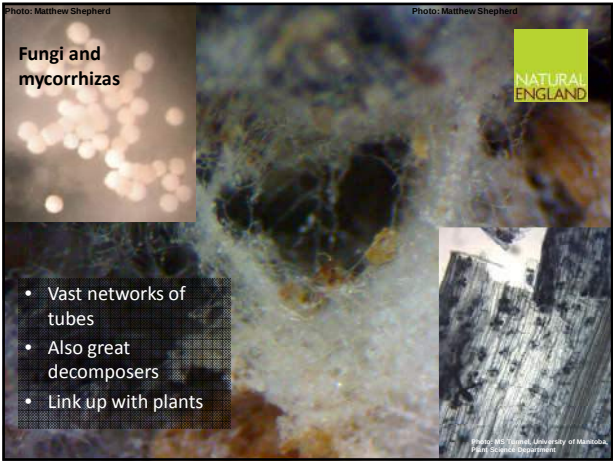


Photo: Matthew Shepherd

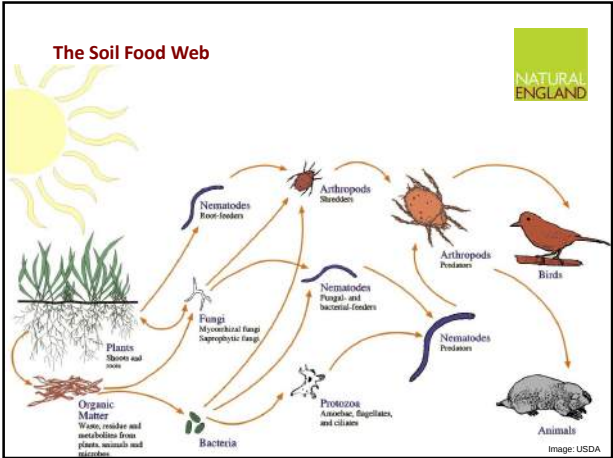
Nematodes and other soil water swimmers

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Earthworms

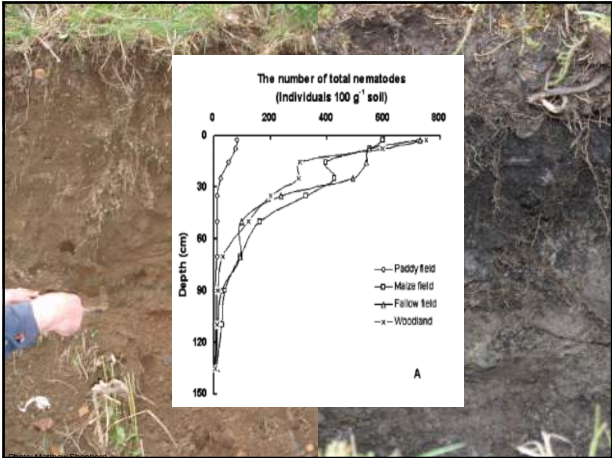
Photo: James Lindsey, CC BY-SA 3.0

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Biomass and numbers

# INDIVIDUALS	In a handful of soil...	# SPECIES
100,000,000,000 50,000 m	BACTERIA FUNGI	10,000
100,000 10,000	PROTOZOA NEMATODES	100
5000	INSECTS ARACHNIDS MOLLUSCS WORMS	100
0.001	MAMMALS	0.001
500 m	PLANT ROOTS	10

Image: Karl Ritz, Cranfield University



Soil structure

- Most soils wouldn't have structure without soil life
- How? Like a morning in a playgroup!



Moving



Eating



Painting



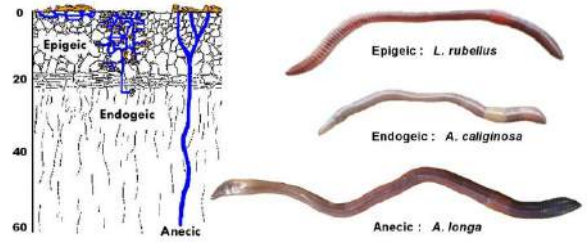
Gluing



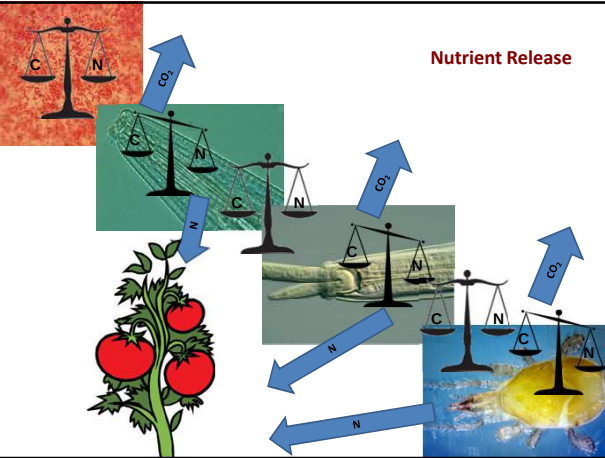
Sewing



Drainage and pore connectivity

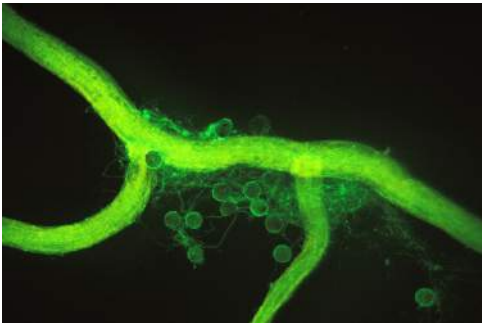


Nutrient Release

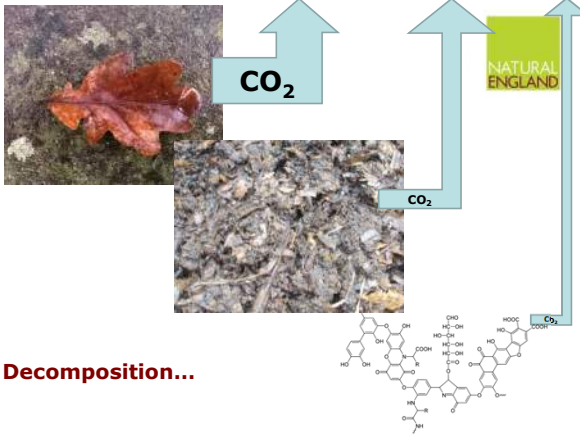


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Nutrient (and water) capture



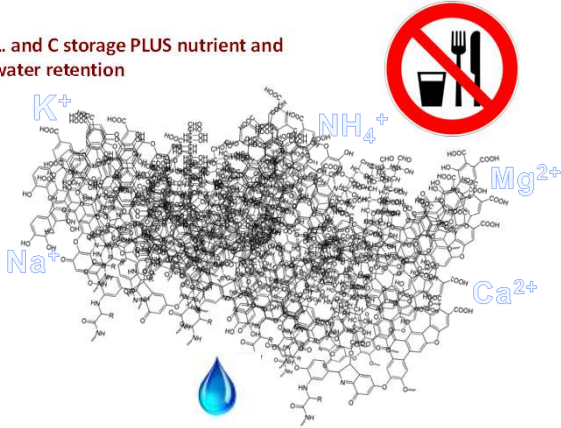
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Decomposition...

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... and C storage PLUS nutrient and water retention



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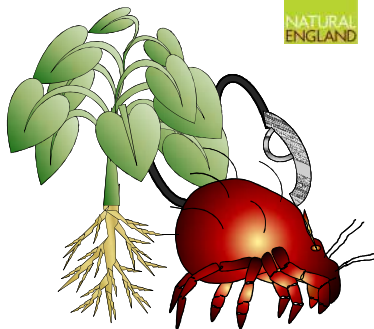
Pest Control?

- A large, diverse community of non-problem organisms
- Supports many predators
- Predators can also eat pest species and prevent outbreaks.



Soil life works for us

- Soil organisms are "the biological engine of the earth"
- Engines need fuel!
- Organic matter is the fuel...



Illustrations: Matthew Shepherd



SOIL ORGANIC
MATTER? SOIL
BUGS?
WHAT ABOUT
MY INVASION?

"...before we judge of them too harshly we must remember what ruthless and utter destruction our own species has wrought, not only upon animals, such as the vanished bison and the dodo, but upon its inferior races."

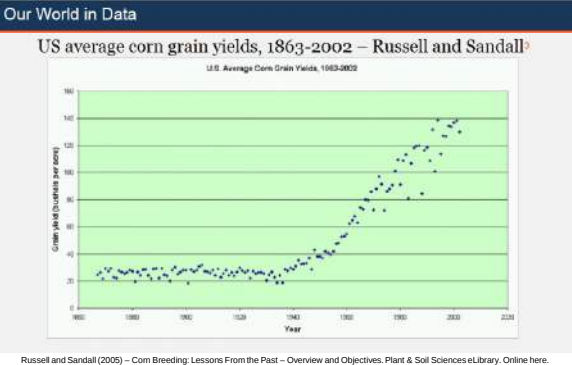
H.G. Wells

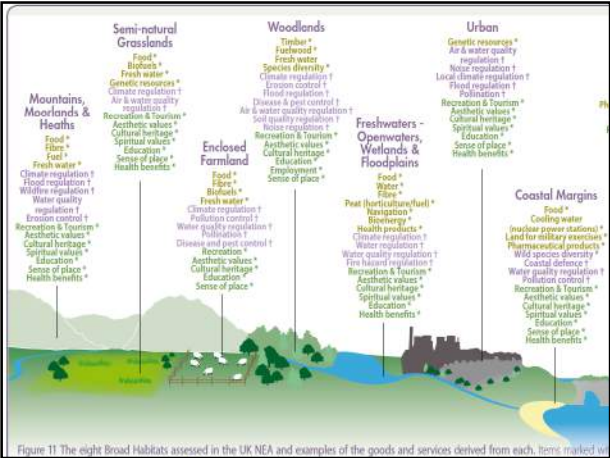
What do we do to soil life?

- Cultivation – removes OM source (weeds!), kills larger worms, and releases stored soil C
- Monocropping – same C sources reduce diversity in soil
- Agrochemicals
- Traffic - compaction
- Not feeding the soil – soil stops working!

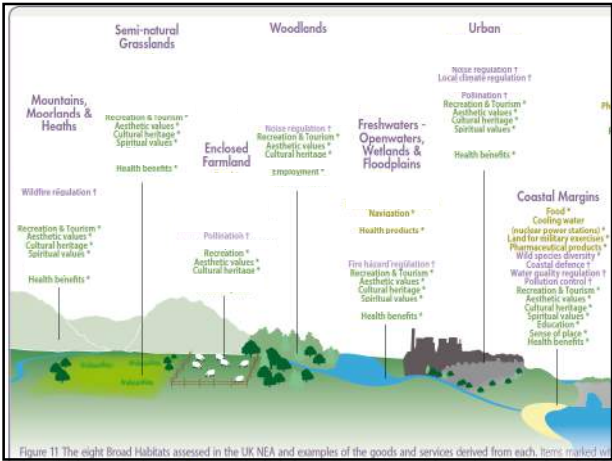


What do we do to soil life?



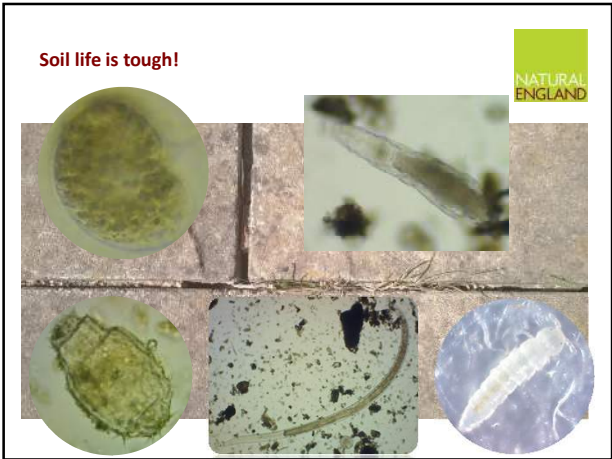








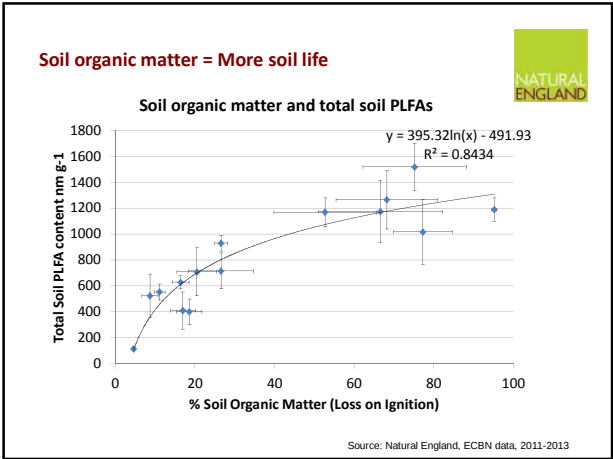


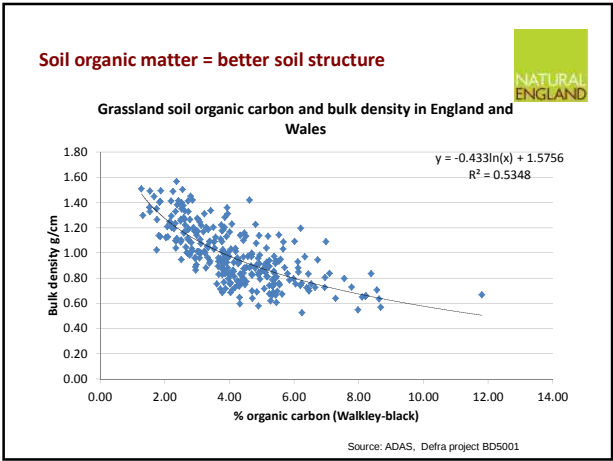


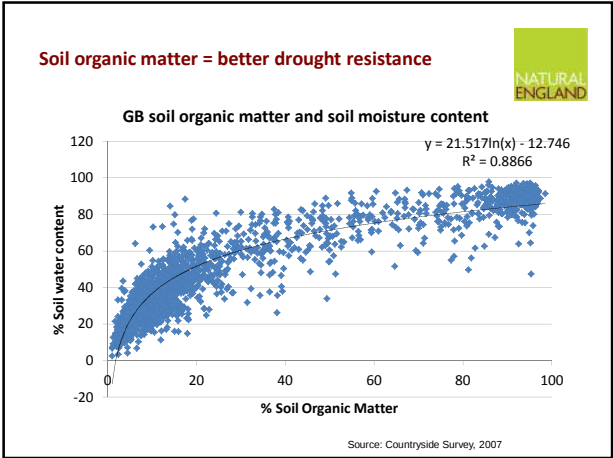
Looking after soil life

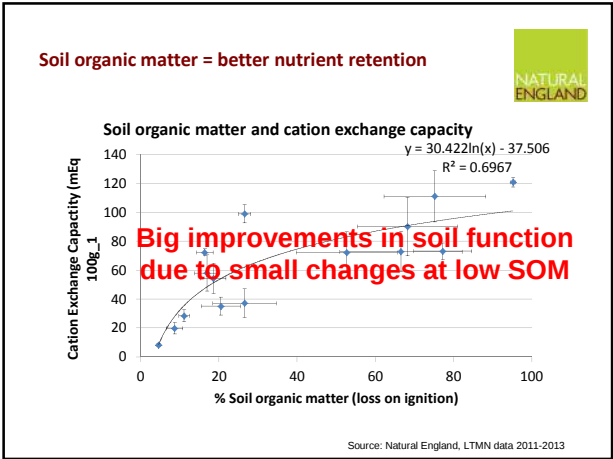
- More fuel: organic matter - put more in, or lose less
 - Manures – tricky if you don't have livestock
 - Composts - Stabilised C and N, can increase crop yield by 250%*
 - Grow more plants destined for the soil: cover crops etc.
- Disturb the soil less – lose less C
- More diverse crops

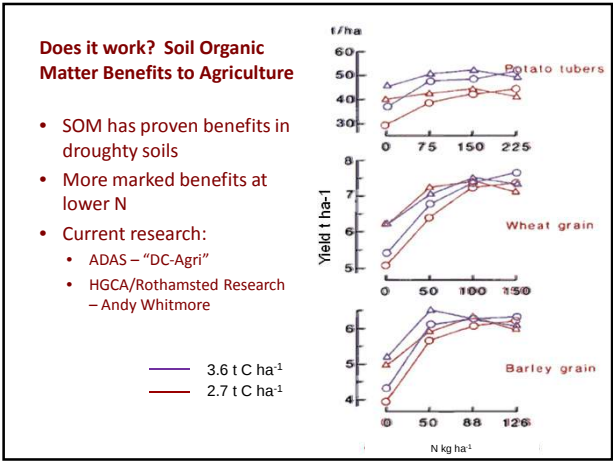
*Diacono & Montemurro, Agronomy for Sustainable Development April 2010, Volume 30, Issue 2, pp 401-422











Does it work? Farmer perception...

Source of case study

Net annual financial benefit (£/ha) after 5-8 years

Defra project number	Arable	Livestock	Mixed	All
SP0310	£61 (10) ¹		£58 (8)	£60* (18)
SP08014	£83 (6)	£98 (6)	£103 (11)	£96* (23)
Average	£69 (16)	£98 (6)	£84 (19)	£80 (41)

Table 1: Net annual financial benefits £/ha from SOM management by farming system

¹ Numbers in parentheses show number of case studies in each category.

* Statistically significant, ANCOVA F = 5.381, P = 0.026

Defra project: SP08014



Is it working? A deeper look...

- Compare fields on similar soils or near fencelines
- Measure SOM and look at typical ranges for soil type
- Biological tests need more benchmarking
 - Soil communities – mites and springtails
 - DNA – whole communities from a single analysis

Is it working? A deeper look...

- Soil function – decomposition of different substrates or bait sticks
- Bulk density
- Infiltration
- Earthworms

Conclusions



- Soil organisms are a huge diverse community working for us
- They provide a vast array of valuable services to farmers
- They can't do this without fuel – organic matter
- If the soil stops working, the consequences can be disastrous
- Farmers can help by feeding the soil, so it can get back to work
- Doing this can help make farming more profitable
- You can test your soil health by digging a pit and looking for good soil structure



