A new integrated land degradation assessment approach considering soil biodiversity, humus forms and vegetation

Siniscalco C.,
Bigaran F., Gratani L.,
Jacomini C., Sartori G.

Italian Society of Soil Sciences (SISS)
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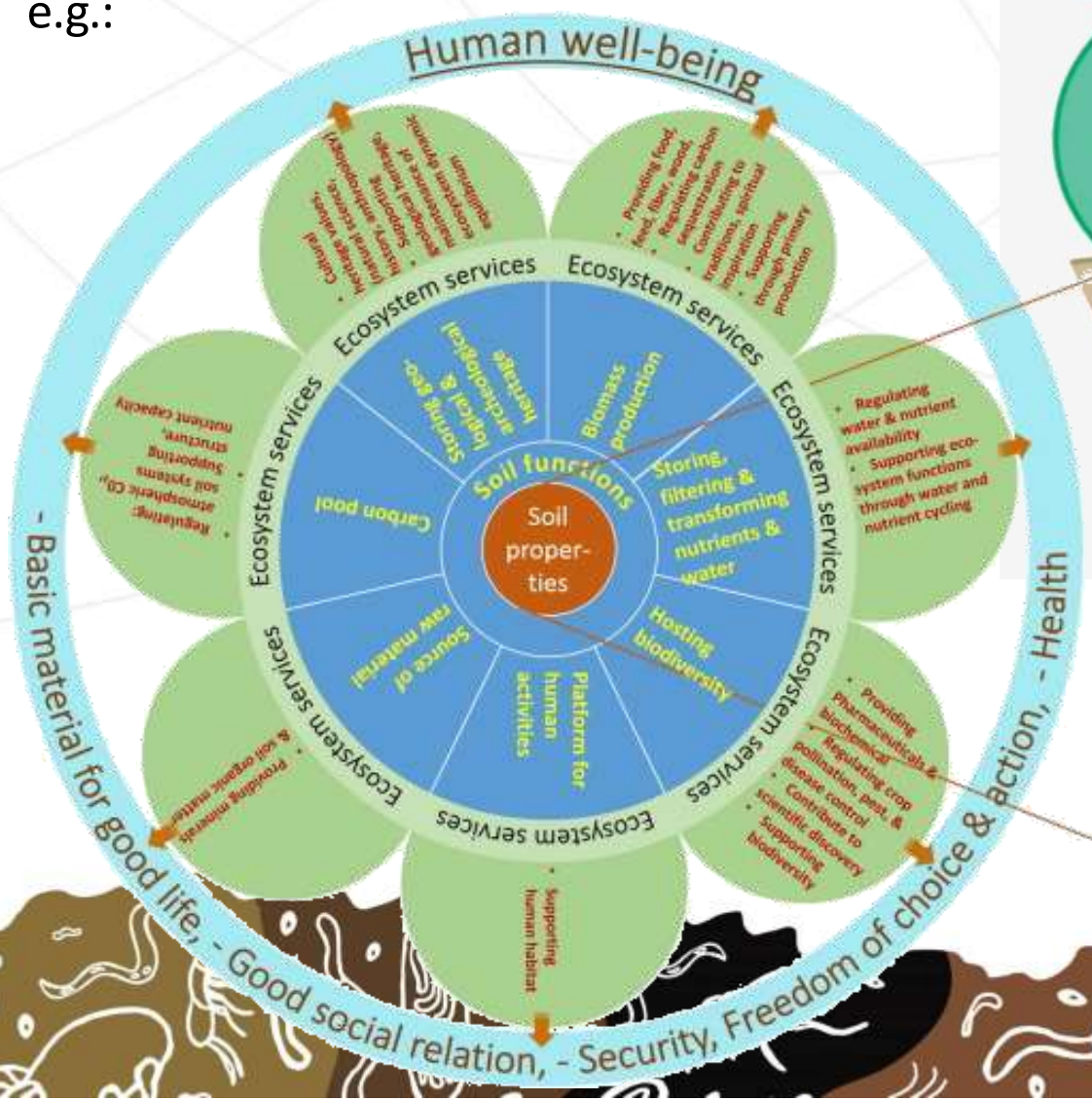
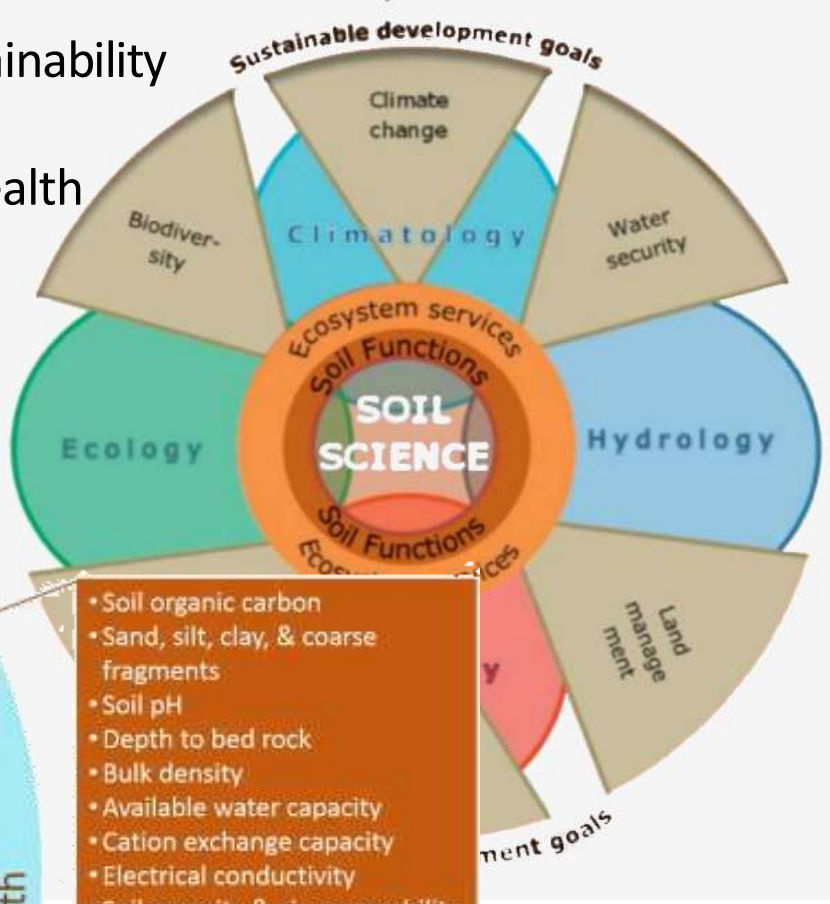
Soil performs essential ecosystem services for sustainability

There are several indicators useful to monitor its health

e.g.:

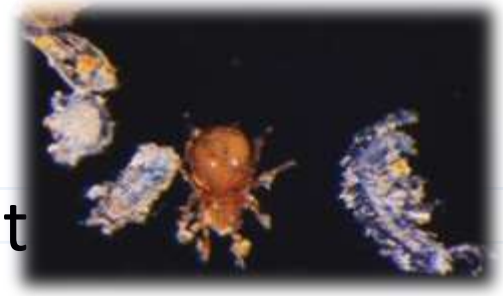




- Soil organic carbon
- Sand, silt, clay, & coarse fragments
- Soil pH
- Depth to bed rock
- Bulk density
- Available water capacity
- Cation exchange capacity
- Electrical conductivity
- Soil porosity & air permeability
- Hydraulic conductivity & infiltration
- Soil biota
- Soil structure & aggregation
- Soil temperature
- Clay mineralogy
- Subsoil pans

Spatial and temporal scales have a key role in soil monitoring

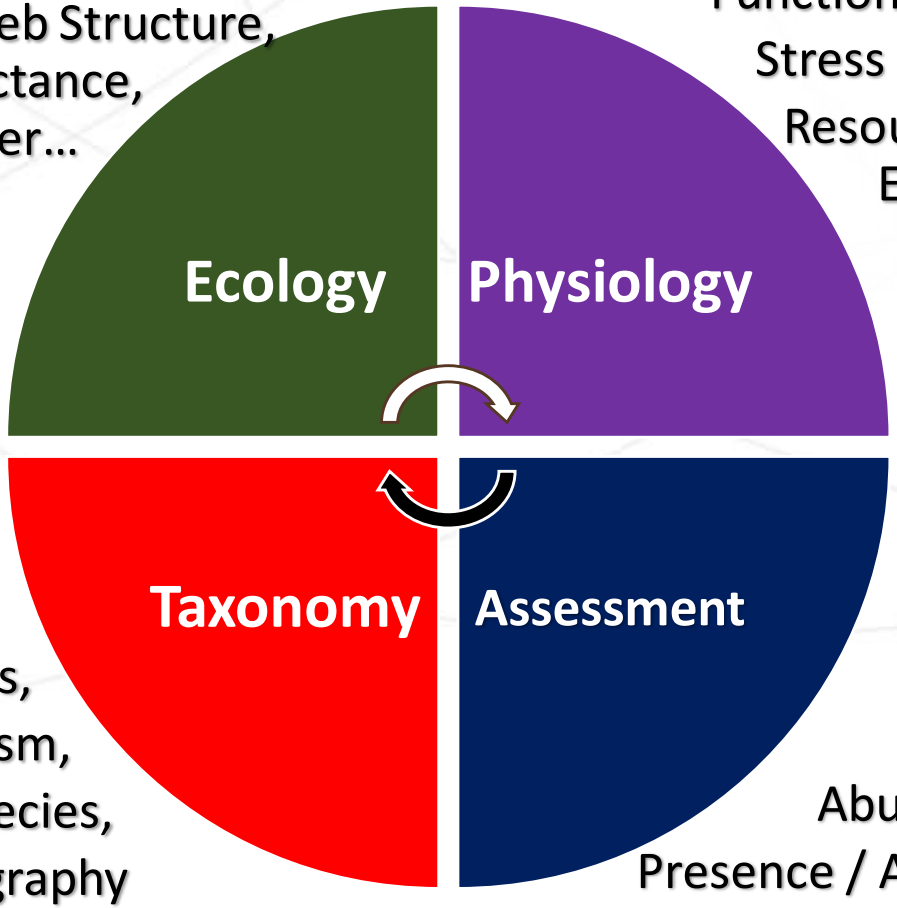
1:250,000	• Ecological Region
÷	• Region (Admin.)
1:25,000	• Landscape
1:2,500	• Farm
÷	
25:1	• Point



Integrated holistic monitoring

Adaptive Strategies,
Foodweb Structure,
Connectance,
Turnover…

Functional Traits,
Stress Impacts,
Resource-Use
Efficiency



Richness,
Endemism,
Rare species,
Biogeography

Indices,
Abundance,
Presence / Absence,
Long-Term Monitoring…


Soil

Humus



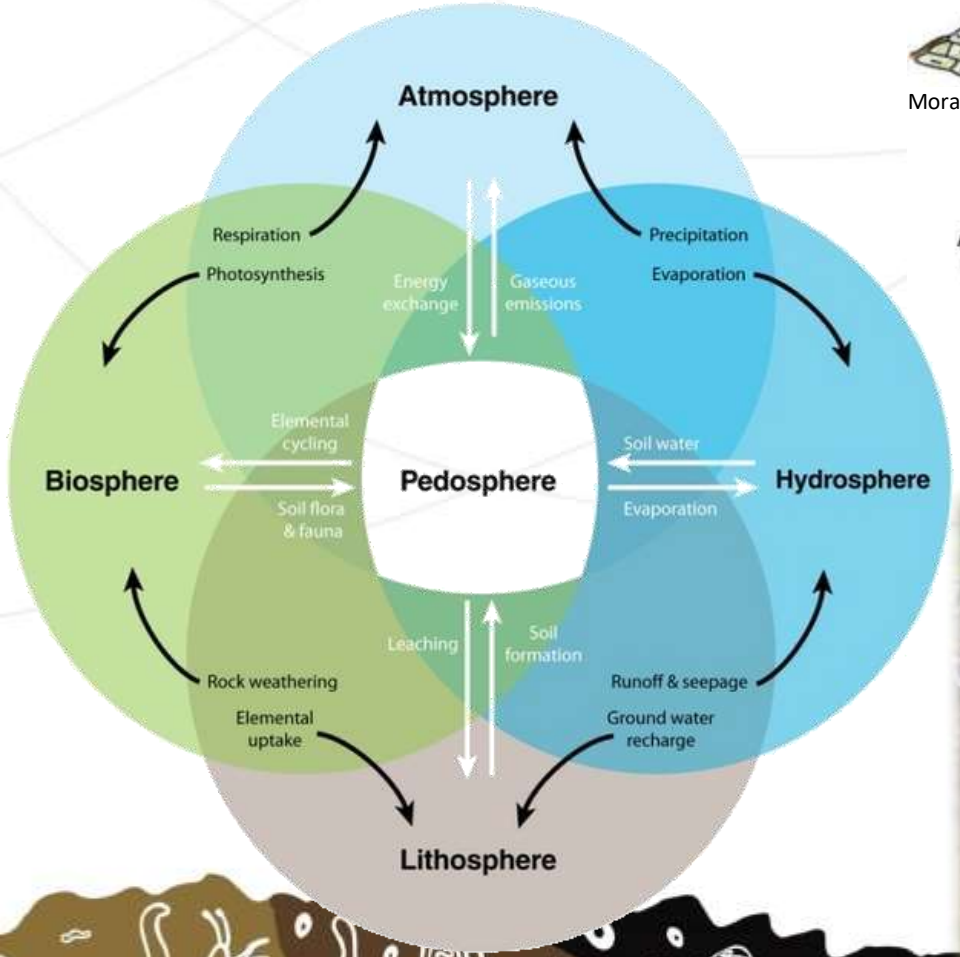
Fungi

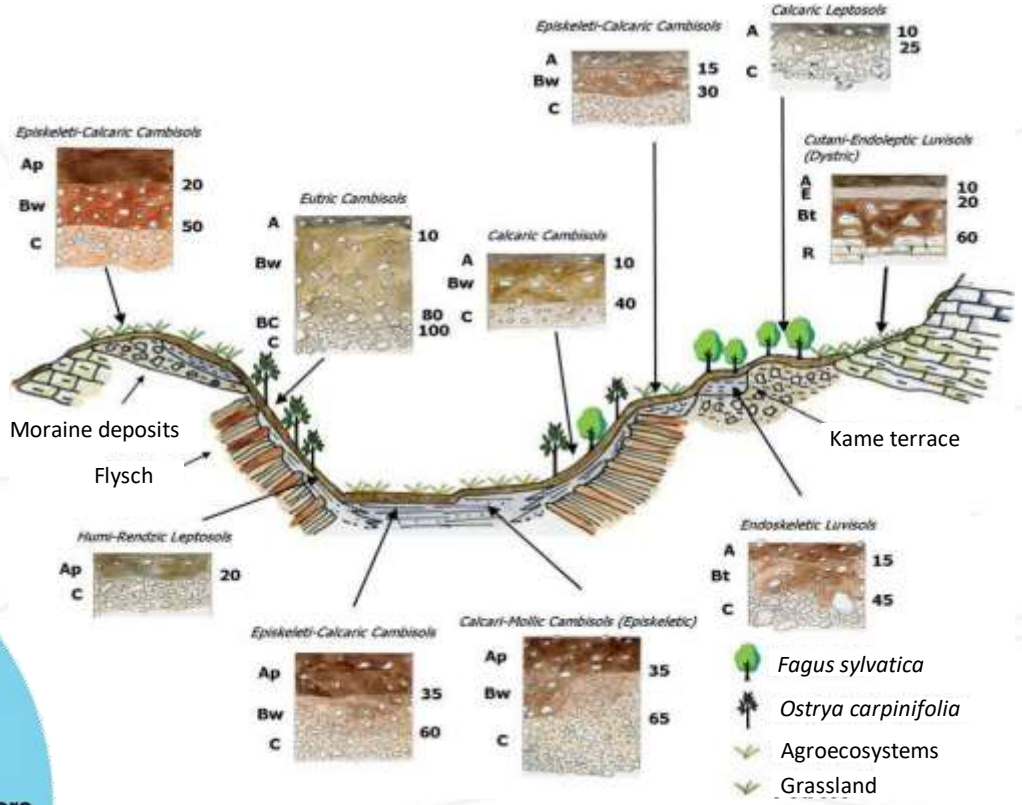
Vegetation



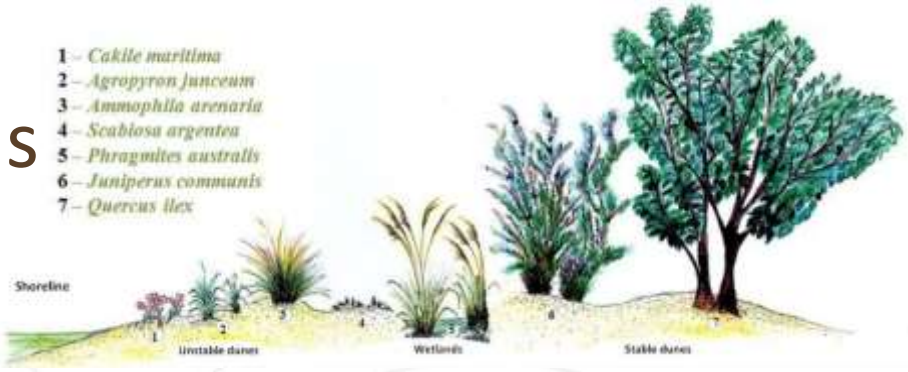
Soil Fauna

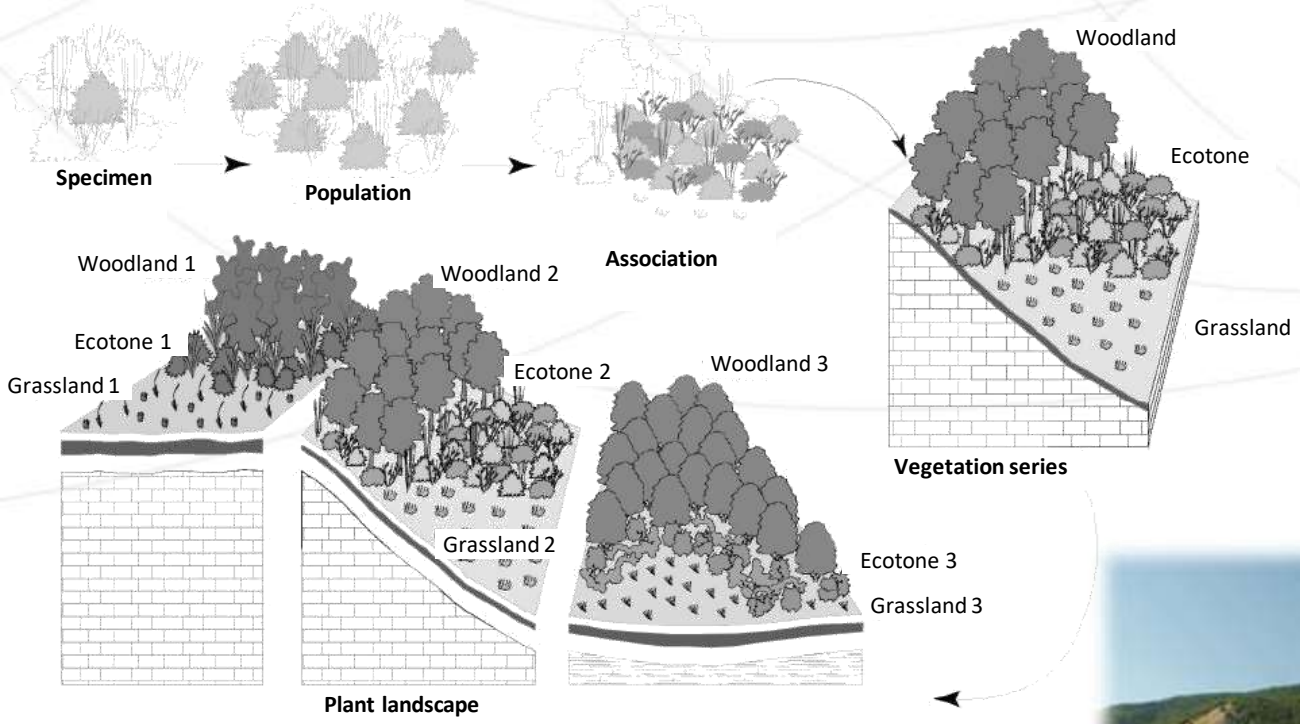
Soil: Common element, historical and evolutive matrix





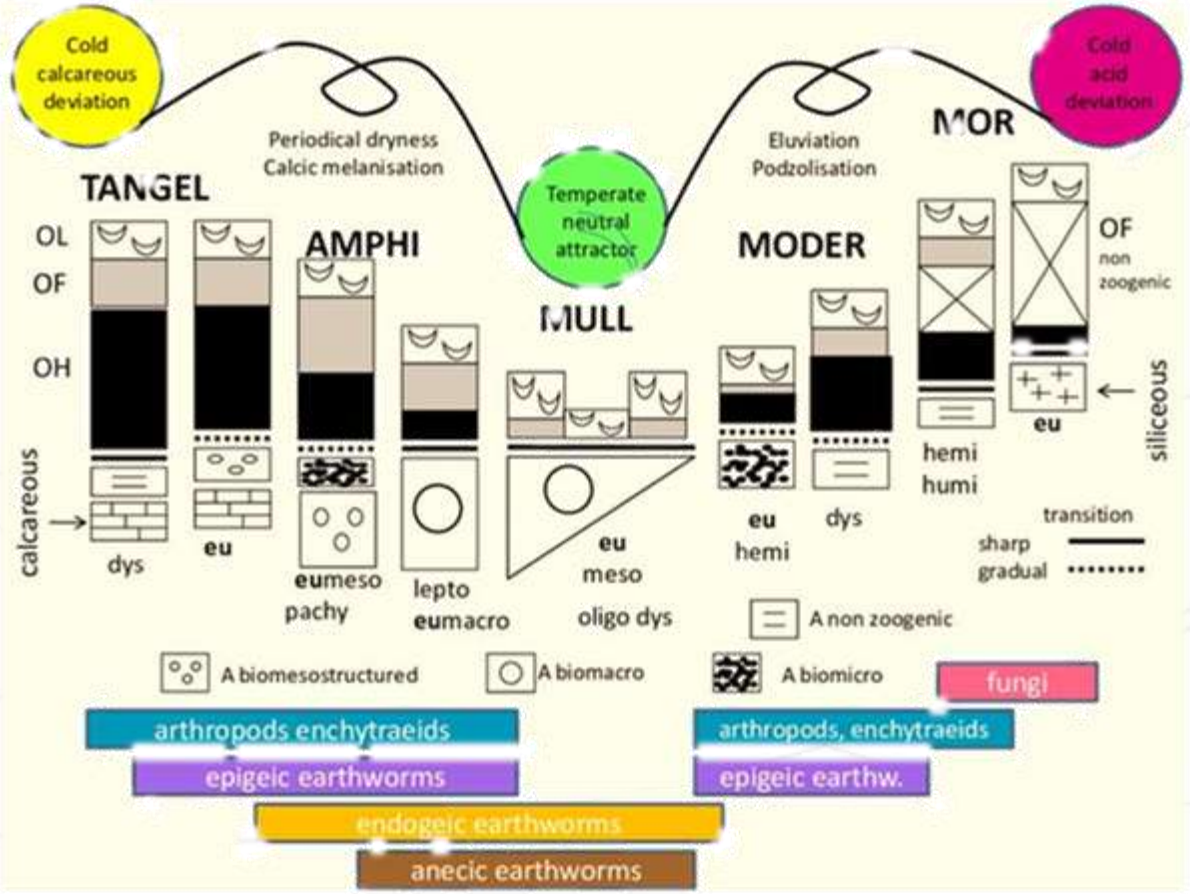
Vegetation: visible representation of ecosystems (µbioma, etc.)

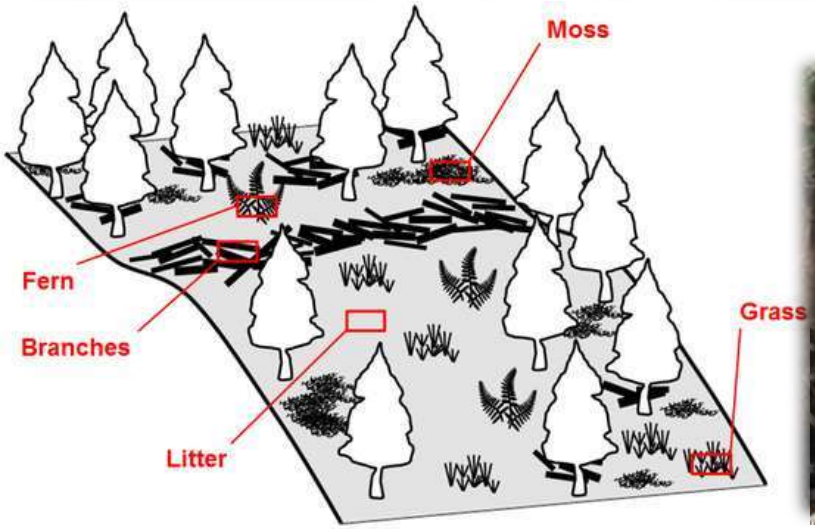




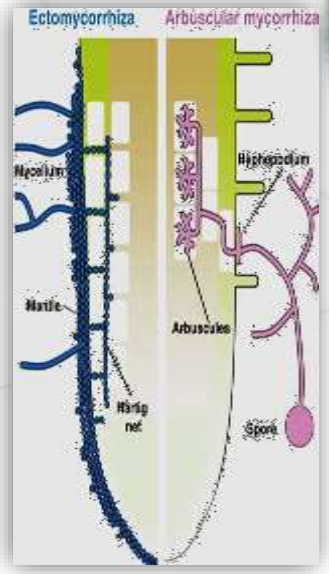
Humus:

link between soil and biota;
seat of OM degradation and humification

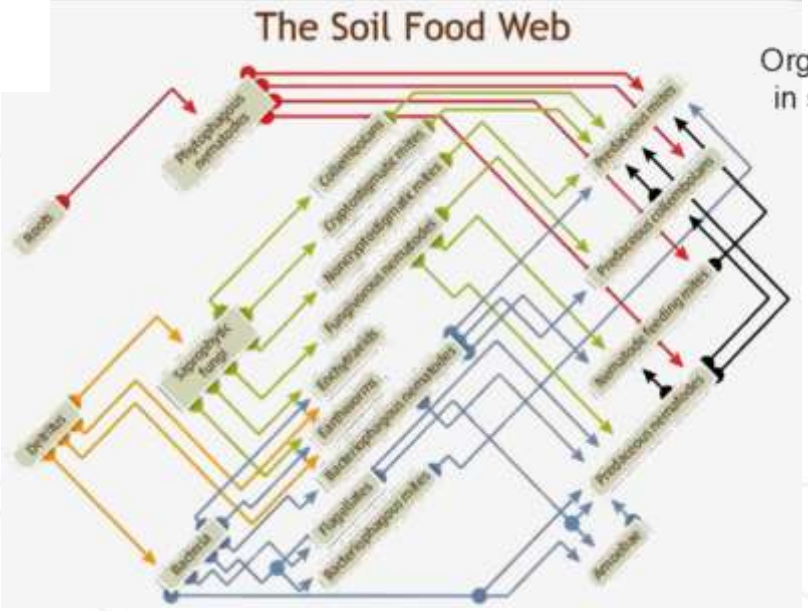




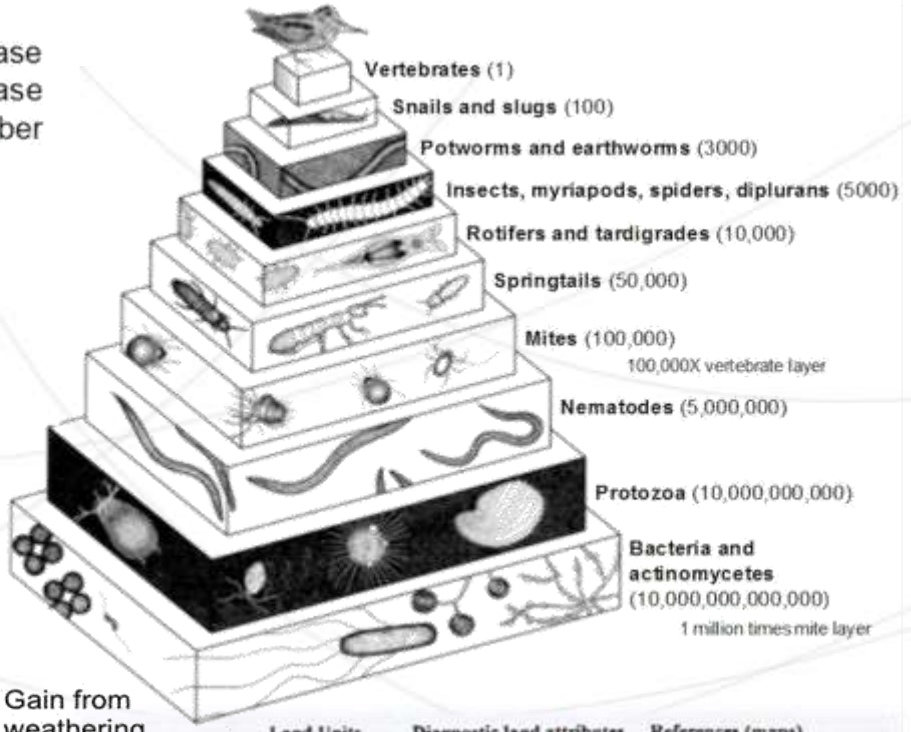
Fungi:
key role
in nutrient cycle
& ecosystem stability

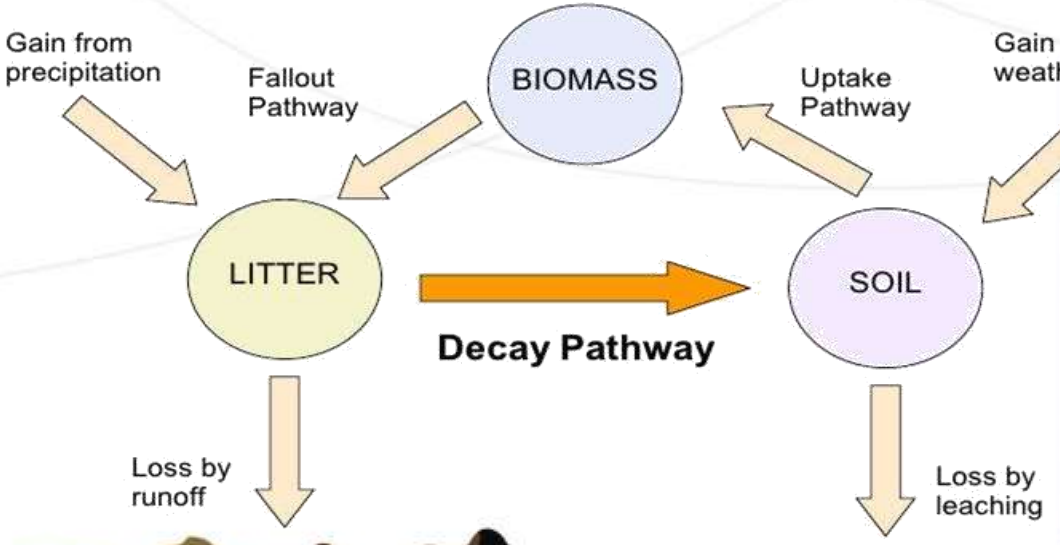


Wood-wide-web, mycorrhizas and humus forms entangle Soil Biota



Organisms decrease in size and increase in number

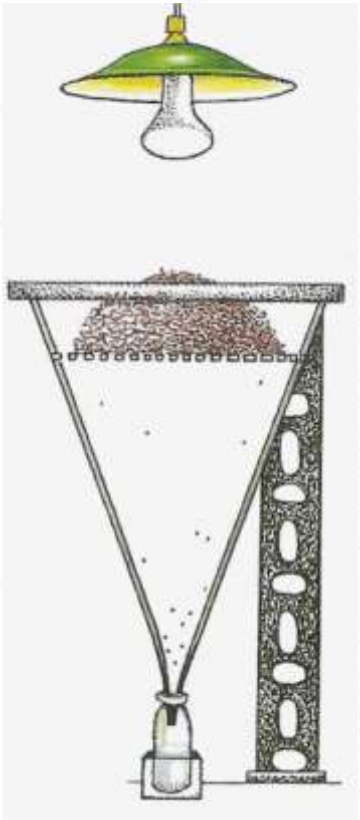




Land Units s.l. and scale	Diagnostic land attributes	References (maps)
Land regions >1:250,000	Bioclimate	Blasi, 1994
Land systems 1:250,000	Main lithological land geographical features	Almagia, 1976 Brondi, 1996
Land facets 1:50,000 / 1:250,000	Lithomorphology, climatic types, vegetation (alliances) and main land uses	Bigi et al., 1988 Blasi, 1994; CORINE Land Cover, 1992
Land units 1:10,000 / 1: 50,000	Land use, vegetation, (associations), lithology, physiography and main groups of soils	unpublished and original Land-cover/vegetation map, Regione Lazio; Sevink et al. 1984
Elements 1:5,000 1:10,000	Detailed vegetation-land cover, soils and morphology	Unpublished soil data and original vegetation map

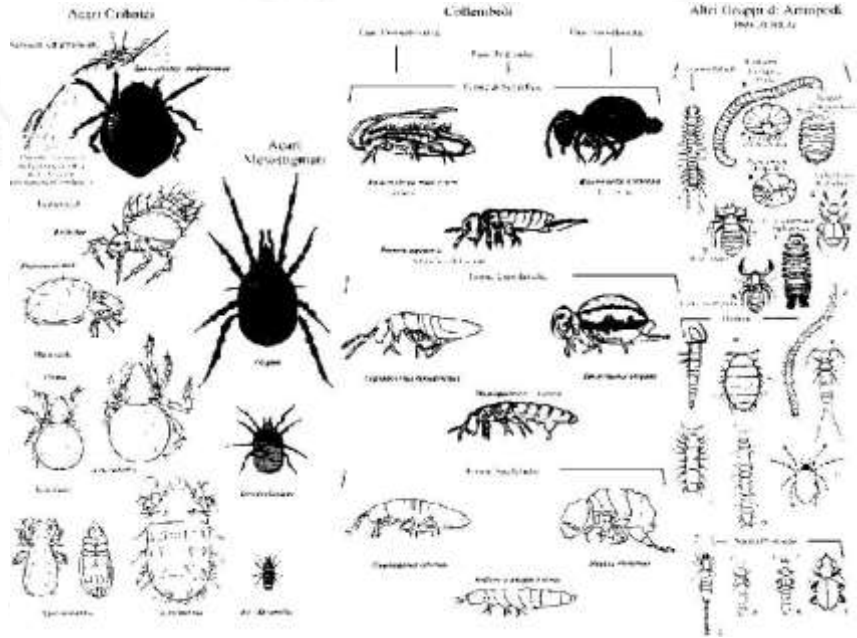
Soil Mesofauna community

Detritus soil web allows to assess several trophic or functional levels and to relate them with soil quality & threats



Group	EMI score
Protura	20
Diplura	20
Collembola	1–20
Microcoryphia	10
Zygentomata	10
Dermaptera	1
Orthoptera	1–20
Embioptera	10
Blattaria	5
Psocoptera	1
Hemiptera	1–10
Thysanoptera	1
Coleoptera	1–20
Hymenoptera	1–5
Diptera (larvae)	10
Other holometabolous insects (larvae)	10
Other holometabolous insects (adults)	1
Acari	20
Araneae	1–5
Opiliones	10
Palpigradi	20
Pseudoscorpiones	20
Isopoda	10
Chilopoda	10–20
Diplopoda	10–20
Pauropoda	20
Symphyla	20

(Parisi *et al.*, 2005)



https://www.chaosofdelight.org

Indicators proposed to assess land degradation in a holistic way

- Soil Type
- Soil Depth
- Soil Texture
- OC content in A horizon
- AWC

Soil

- Trait-Based Ecology
- Vegetation pattern
- Habitat connection
- Presence of alien species
- Presence of endemisms

Vegetation

- Presence of organic horizon
- Type of organic horizon
- pH
- Spatial distribution

Humus forms

- QBS-ar Index
- QBS-c Index
- Richness
- Abundance

Mesofauna

- Functional Group Ratios:
  % of mycorrhizal fungi
  % of parasite fungi
- % of saprobic fungi
- Indicator species

Fungi

Conclusions

An assessment of land degradation integrating soil, humus forms, vegetation, fungi and soil fauna is proposed as an innovative approach

Our integrated method uses simple and easy-to assess parameters and indicators that could provide a holistic and tailored methodology to assess land degradation with existing data, on several scales of investigation and with a good resolution


Thank you for
your attention
... to soil biodiversity!