FARMING PRACTICES AND SOIL BIODIVERSITY

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OUTLINE

- Soil biodiversity
- Ecosystem services
- Cropping systems
  - What is good and bad for soil biodiversity
  - CA-Conservation Agriculture
- Two cases of functions delivered by soil invertebrates
- A framework for soil quality assessment
SOIL FAUNA IN COW-EQUIVALENTS

A grassland can feed one cow per ha.

Soil fauna biomass: 5 tons per ha

<table>
<thead>
<tr>
<th>Approximate range of biomass of each major component of the biota in a typical temperate grassland soil.</th>
<th>Biomass t ha⁻¹</th>
<th>Cow equivalents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant roots</td>
<td>20–90</td>
<td>100</td>
</tr>
<tr>
<td>Bacteria</td>
<td>1–2</td>
<td>2–4</td>
</tr>
<tr>
<td>Actinomycetes</td>
<td>0–2</td>
<td>0–4</td>
</tr>
<tr>
<td>Fungi</td>
<td>2–5</td>
<td>4–10</td>
</tr>
<tr>
<td>Protozoa</td>
<td>0–0.5</td>
<td>0–1</td>
</tr>
<tr>
<td>Nematodes</td>
<td>0–0.2</td>
<td>0–½</td>
</tr>
<tr>
<td>Earthworms</td>
<td>0–2.5</td>
<td>0–5</td>
</tr>
<tr>
<td>Other soil animals</td>
<td>0–0.5</td>
<td>0–1</td>
</tr>
<tr>
<td>Viruses</td>
<td>Negligible</td>
<td></td>
</tr>
</tbody>
</table>

PAUL HENNING KROGH
SENIOR RESEARCHER
WHAT DO THEY DO?

**Soil Biodiversity**
- Microorganisms
  - AM
  - Mycorrhiza
  - Saprotrophes
  - Bacteria
- Microfauna
  - Nematodes
  - Protista
- Mesofauna
  - Enchytraeids
  - Springtails
  - Mites
- Makrofauna
  - Earthworms

**Functions**
- Decomposition of organic matter
- Nutrient cycles
- Soil structure
- Soil health
- Water infiltration

**Ecosystem services**
- Food and fibre
- Disease control
- Climate regulation
- Carbon sequestration
- Water balance
- Productivity

**WHAT DO THEY DO?**

- **Microorganisms**
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  - **Soil health**
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- **Microfauna**
  - Nematodes
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- **Mesofauna**
  - Enchytraeids
  - Springtails
  - Mites
  - **Climate regulation**
  - **Carbon sequestration**

- **Makrofauna**
  - Earthworms
  - **Water balance**
  - **Productivity**
IMPORTANT ELEMENTS IN CROPPING SYSTEMS AFFECTING SOIL BIODIVERSITY

- Tillage
- Fertilizer type
- Crops and cropping sequences
- Litter
- Pesticides
TILLAGE AND NO-TILLAGE

Conventional ploughing  Reduced tillage  Conservation agriculture (CA)

Source: www.GMSR.dk
CONSERVATION AGRICULTURE

- Continuous minimum mechanical soil disturbance.
- Permanent organic soil cover: plant remains or cover crops.
- Diversification of crop species grown in sequences and/or associations.
- At least 30% of area covered by plant residues

In addition:

- Utilization of green manures/cover crops (GMCC's) to produce the residue cover.
- No burning of crop residues.
- Integrated disease and pest management.
- Controlled/limited human and mechanical traffic over agricultural soils.

Sources: FAO, ECAF, Cornell’s CA Group
COMPOSITE TRAIT: THREE EARTHWORM LIFE-FORMS

- **Anecic**
  - eats on the soil surface
  - vertical burrows
- **Endogeic**
  - consumes in upper soil horizon
  - unpigmented or weakly pigmented
- **Epigeic**
  - reside and eat on the soil surface in the organic matter
  - small, highly reproductive
L. TERRESTRIS DRAGS FOOD INTO ITS BURROW
EXCREMENTS CONSTANTLY FORMED ON THE SOIL SURFACE
THE "EXTERNAL RUMEN"

Earthworm Interaction Soil

The soil is coprogenic – made up of earthworm excrements
BURROWS OPENING ON THE SOIL SURFACE
HUMUS LINING
10 CM DEPTH
TRACING HYDROLOGICALLY ACTIVE BIOPORES
LACK OF MAKROPORES IN TOP SOIL

35% more infiltration

COMPOSITE TRAIT: THREE EARTHWORM LIFE-FORMS

Epedaphic

Hemiedaphic

Euedaphic
THE FOODWEB IN RELATION TO BENEFICIAL PREDATORS:

THE BROWN AND THE GREEN FOOD CHANNEL

Source: Jamin Dreyer
THE DOGMA

Farming system
Agricultural land
Species

Traits

Ecosystem services
A DATA WAREHOUSE SOLUTION: THE EUedaphobase INITIATIVE

Data collection

Ecological traits

Standardization

Data warehouse

Soil quality assessment tools

Edaphobase
PERSPECTIVES

- *The Farming System* is the complex impact-factor system from beneficial and detrimental
- A data warehouse of European soil biodiversity data and metadata for predicting future agricultural use scenarios and soil quality assessment
- Functional trait databases must be extended and shared
- Valuation of ecosystem services, must extend the functional description of soil biodiversity