This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817819

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CASE STUDY 12

Ecological groups of earthworms

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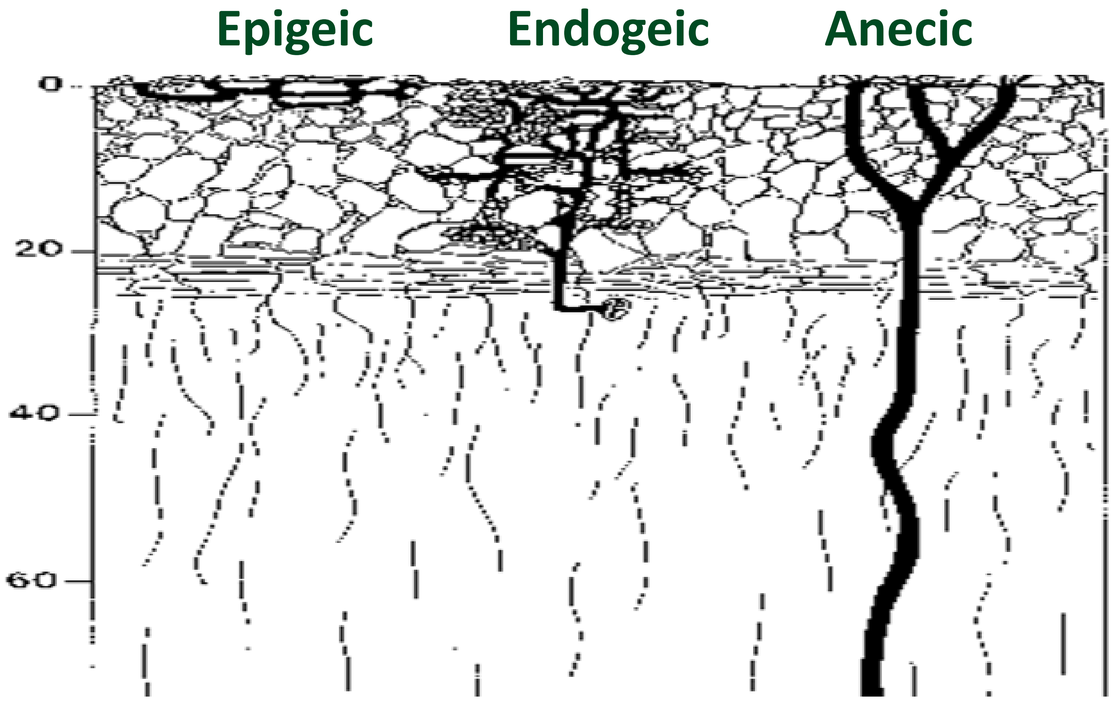

Schematic representation of three ecological groups of earthworms, adapted from (Fraser and Boag 1998)

Objective

Earthworms belong to the class *Oligochaeta*. There are about 220 species of lumbricids, of which 19 are common in Europe. A total of 13 different species of earthworms have been found in various soil layers in Estonia, from humus horizon to the depth of a couple of meters. This number is smaller in comparison with other regions in Europe, e.g., the number of species of earthworms is 24 in Germany, 30 in Norway, 57 in Italy, 33 in USA, 16 in Finland.

The four main management inputs into farming system are cultivations, cropping patterns, fertilization and crop protection. Each of these four inputs interacts strongly with earthworm populations:

- The effects of cultivations. The decreased number of earthworms that occur in cultivated arable land could be due to mechanical damage during cultivation, to the loss of the layer of vegetation, to a decreased supply of food as the organic matter content gradually decreases with repeated cultivations, or to predation by birds when earthworms are brought to the surface during cultivation.
- The effect of cropping. The most important factor controlling earthworm populations in arable land is the amount of organic matter that is available as food for earthworms. The availability of food can limit the numbers of earthworms in grassland and arable land. The cropping can influence the number of earthworms in arable land considerably and the numbers of earthworms change every year according to the phase of the rotation. One of the more important factors affecting the influence of cropping on earthworm populations is the proportion of the plant material that is returned to the soil after harvest.
- The effect of fertilizers. The effects of fertilizers (organic or inorganic) on earthworms may be direct by changing the acidity of soil or through toxicity, or indirect by changing the form and quantity of the vegetation that ultimately turns into decaying organic matter that provides food for earthworms. Liquid organic manures can have short-term adverse effect on earthworm population due to their ammonium and salt contents, but population usually recover quickly and increase thereafter.
- The effect of chemicals. The chemicals that reach soils include pesticides and heavy metals. The degree of exposure of earthworms to such chemicals in soils depends upon a wide range of variable factors that may be associated not only with the chemical, the route of exposure and the soil type, but also the environmental conditions and the species and behavior of the earthworms. Earthworms' species can be exposed to chemicals to quite different degrees and in very different ways.

Based on their life habits, the earthworms are divided into three ecological groups, and earthworms belonging to these groups are somewhat similar in terms of their appearance, behavior and feeding habits.

Data on earthworms in case study 12 are presented on a poster on "Impact of soil management practices on the abundance and diversity of the soil earthworm community"

Epigeic

Epigeic species relate to soil surface and humus layer, they are found in almost all natural habitats, the specimens are small, and their front end or entire body has dark pigmentation. They all feed on plant residues, turning and chopping it, which significantly accelerates the rate of decomposition of such residue.

Some species usually live in forest litter (*Dendrobaena octaedra* (Savigny, 1826), *Dendrodrilus rubidus* (Savigny, 1826) while others prefer humus layer of grassland (*Lumbricus castaneus* (Savigny, 1826). *Lumbricus rubellus* Hoffmeister, 1843 copes equally well in forest, grassland or even fields. *Eiseniella tetraedra* (Savigny, 1826) is so well adapted to living in nutrient-rich humus layer of temporarily flooded grasslands that this species is viewed as indicator species for flooding.

Highly acidic pine forest humus suits for only a few species (*Dendrobaena octaedra*, *Dendrodrilus rubidus*), who are not very abundant and thus the decomposition process takes place at a much slower pace.

Eiseniella tetraedra
Photo: Graham Calow https://www.naturespot.org.uk/species/eiseniella-tetraedra#gallery-1

Lumbricus castaneus
Photo: Stephen Luk https://pbase.com/splluk/image/165473202

Endogeic

Endogeic earthworms inhabit topsoil, which is full of plant roots and there is plenty of organic matter to support earthworm activity. Their food consists in organic matter found in soil and soil microbes surrounding it. These worms move in the soil, forming both horizontal and vertical burrows. When creating these burrows, they eat large quantities of soil, which passes through their digestive tract: organic matter found in soil is digested, minerals are excreted as droppings or coprolite. Some species leave their excrements to the ground and some to the walls of burrows, thus providing a suitable substrate for various soil bacteria; burrow walls rich in organic matter represent good environment for plant roots, which often grow along the burrows created by earthworms. **This group is crucial for farmers and gardeners – earthworms belonging to this group loosen and aerate soil and facilitate reproduction of soil microbes.** This life habit is typical to the most common earthworm in Estonia, *Aporrectodea caliginosa* (Savigny, 1826).

The species belonging to this group are often colourful: besides common greyish pink worms, digging the soil may also reveal the species that are green (*Allolobophora chlorotica* (Savigny, 1826)), pink (*Aporrectodea rosea* (Savigny, 1826)), purple (*Octolasion cyaneum* (Savigny, 1826)) and even almost white (*Octolasion lacteum* (Örley 1881)).

Octolasion cyaneum
Photo: Mari Ivask

Allolobophora chlorotica
Photo: Mari Ivask

Anecic

Anecic earthworms live in deep burrows. This group includes our largest earthworms who can form vertical burrows as deep as a few meters: *Lumbricus terrestris* Linnaeus, 1758 and *Aporrectodea longa* (Ude, 1885). The specimens of both species are up to 30 cm long, with dark front and they can move at high speed in vertical burrows. They usually spend most of the day deep in the burrow, but come to surface to feed, preferably at night. They feed on leaves snapped from the vicinity of their burrow. Sometimes they drag leaves down the burrow to eat them undisturbed; that way plant residue, i.e., organic matter ends up deep below the soil surface. Burrows have a significant impact on soil water regime.

Lumbricus terrestris
Photo: Mari Ivask

Aporrectodea longa
Photo: Mari Ivask