Subproject 1: Sampling of infested sites

- Cover as many different environmental conditions as possible (vegetation, soil type, soil temperature and moisture).
- Three different abundances of M. melolontha larvae (0, 1, and 3).
- No other soil macrofauna present, one year of monitoring.

Duration: 01 May 2016 – 30 April 2018

Background

- Already known since the 1990s that some groups of soil invertebrates can emit considerable amounts of CH4 (Hackstein & Stumm 1994).
- Termites included in the global CH4 budget (~3-10 %, Brune 2010).
- “The contribution of methane emission by soil invertebrates other than termites has received only little attention. […] millipedes and scarab beetles may represent globally important source of methane.” (Brune 2010)
- Thus far only incubation studies, except Kammann et al. 2009 (observation of potential effect of soil fauna on soil CH4 concentrations in the field).

Aims

- First quantitative estimate of the importance of scarab larvae for net CH4 soil fluxes.
- Development of a non-invasive field monitoring method to detect scarab larvae.

Target species

- Melolontha melolontha & Melolontha hippocastani (Common Cockchafer and Forest Cockchafer)
- Cause severe damages in agriculture and forestry if species abundance reaches a threshold.

Method overview

A) Chambers

- Net CH4 flux between soil and atmosphere.
- Monitoring of CH4 concentration change in a confined atmosphere over time.
- E.g. discrete gas sampling with syringes and glass vials.
- BUT: no information about gross CH4 production and gross CH4 oxidation in the soil.
- How to detect CH4 production hotspots (i.e. larvae)?

B) Stable carbon isotopes

- Isotope pool dilution technique by von Fischer & Hedin (2002).
- Trace-level addition of isotopically labelled CH4 (13C-CH4) to the chamber headspace.
- Gross CH4 oxidation → effects labeled CH4
- Gross CH4 production → produces unlabelled CH4
- Testing the limits of the Picarro G2201-i Analyzer.

C) Acoustics

- Feeding sounds → bites per minutes (proxy for activity).
- Correlation with gross CH4 production (proxy of metabolic activity of the larvae).
- Quantification of larvae abundance in the soil possible?
- Site-specific calibration of chamber/isotope pool dilution technique for monitoring larvae infestations?

Project structure

Subproject 1: Sampling of infested sites

- Cover as many different environmental conditions as possible (vegetation, soil type, soil temperature and moisture).

Subproject 2: Controlled mesocosm experiment

- Belowground boxes with known soil volume (50 cm x 50 cm area, 40 cm deep).
- Three different vegetation types (grass, carrots, grass + carrots).
- Three different abundances of M. melolontha larvae (0, 1, and 3).
- No other soil macrofauna present, one year of monitoring.

Duration: 01 May 2016 – 30 April 2018