Above- and Belowground Fluxes of CH_4 from Boreal Shrubs and Scots Pine

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Introduction

- The contribution of vegetation to the global CH_4 budget is uncertain.
- Mature Scots pine (*Pinus sylvestris* L.) trees have been discovered to emit CH_4 from both stems and shoots under field conditions.(1)
- Aerobic CH_4 emissions from plants have been extensively studied during the last decade.(2)
- There are few studies of CH_4 flux of boreal forests, and no studies concerning woody shrubs to our knowledge.

Objectives

- We studied above- and belowground CH_4 fluxes from 4 woody plant species representative to boreal upland forests : bilberry (*Vaccinium myrtillus*), lingonberry (*Vaccinium vitis-idaea*), heather (*Calluna vulgaris*), and Scots pine (*Pinus sylvestris*).
- We also examined the effect of the roots to the soil CH_4 flux.
- Furthermore, our objective was to quantify microbes responsible for CH_4 production (methanogenic archaea) and oxidation (methanotrophic bacteria).

Methods

- The plants were grown in microcosms(3) in laboratory in natural organic soil for 20 months.
- We also had control microcosms containing only humus soil.
- The fluxes of CH_4 were measured with the static chamber method (Fig. 1).
- The methanogens and methanotrophs were analysed using quantitative PCR (qPCR) targeting the functional genes *mcrA* and *pmoA*, respectively.

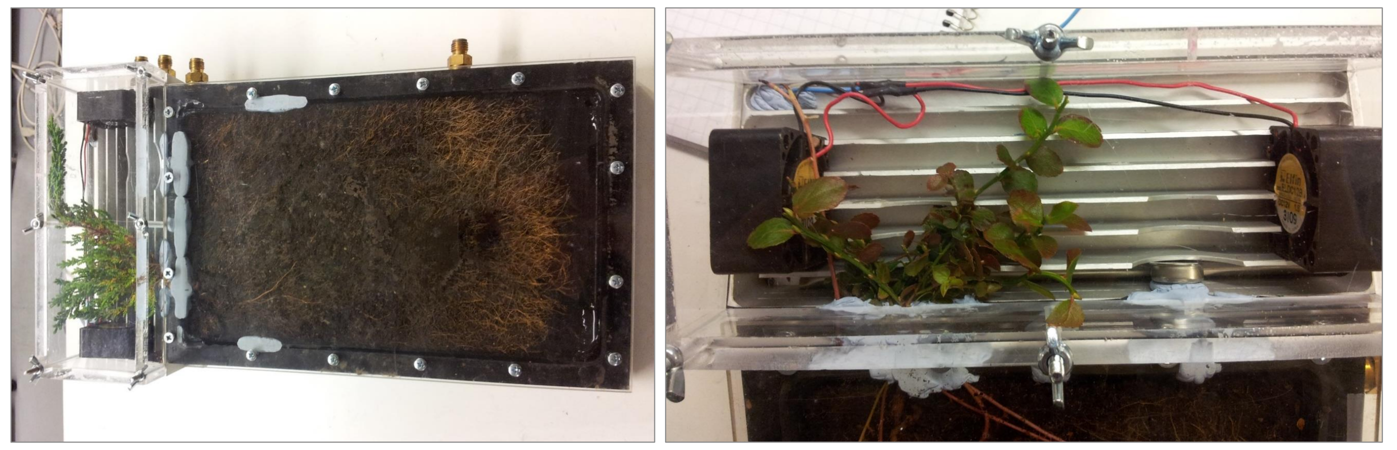

Figure 1. The microcosms.

Results

- The CH_4 fluxes from the roots of all the studied seedlings showed small CH_4 uptake, while the bare soil emitted small amounts of CH_4 (Fig. 2a).
- The shoot fluxes of lingonberry, heather and Scots pine indicated small CH_4 emissions, while the fluxes from bilberry were close to zero (Fig. 2b).
- Based on the preliminary results, methanotrophs in the soil benefit from the presence of plants (Fig. 3).
- Majority of the detected methanotrophs seemed to belong to a group specialized in oxidizing atmospheric levels of CH_4.
- No detectable amounts of methanogens were discovered in any of the samples.

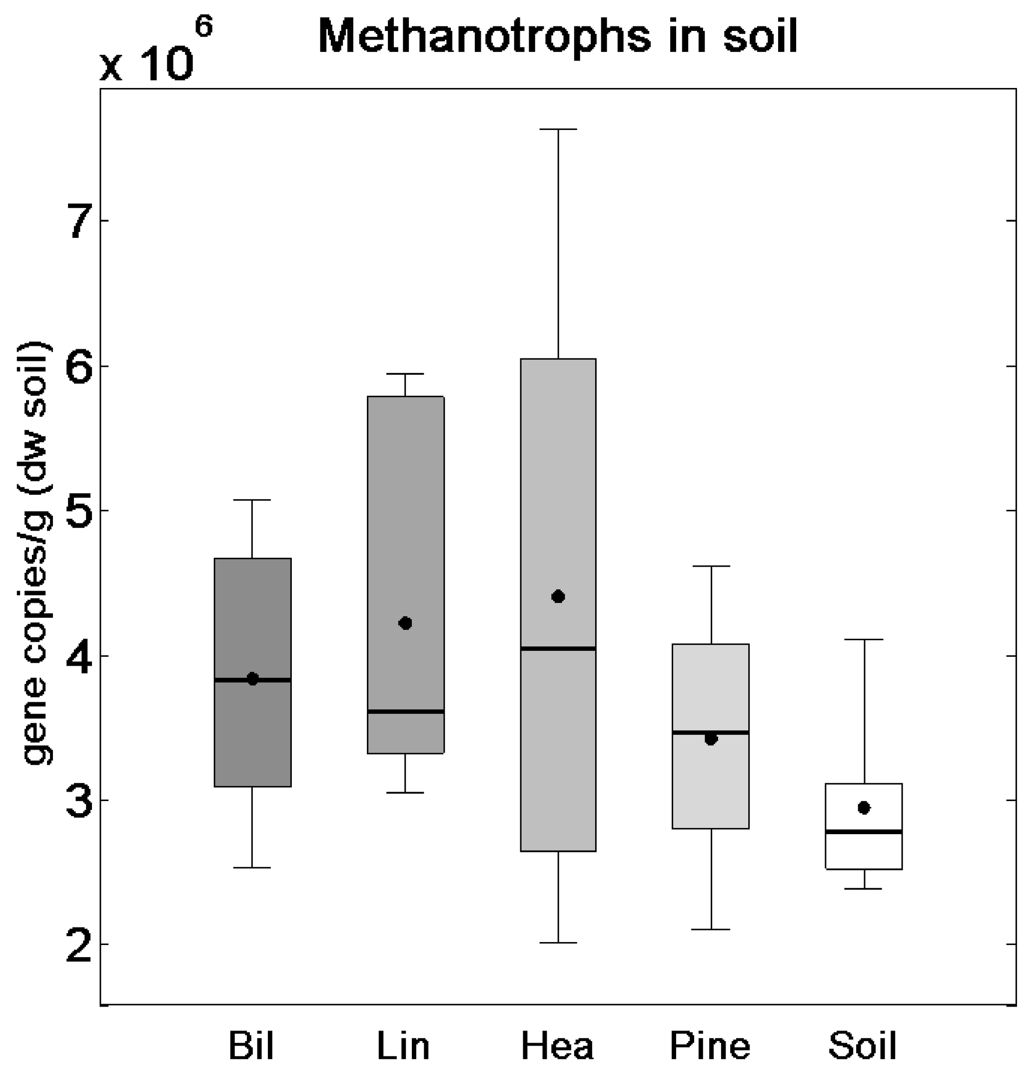

Figure 3. Boxplots of methanotroph related *pmoA* gene copies g^{-1} (DW) from the belowground parts, based on primer pair A189f/A650r.

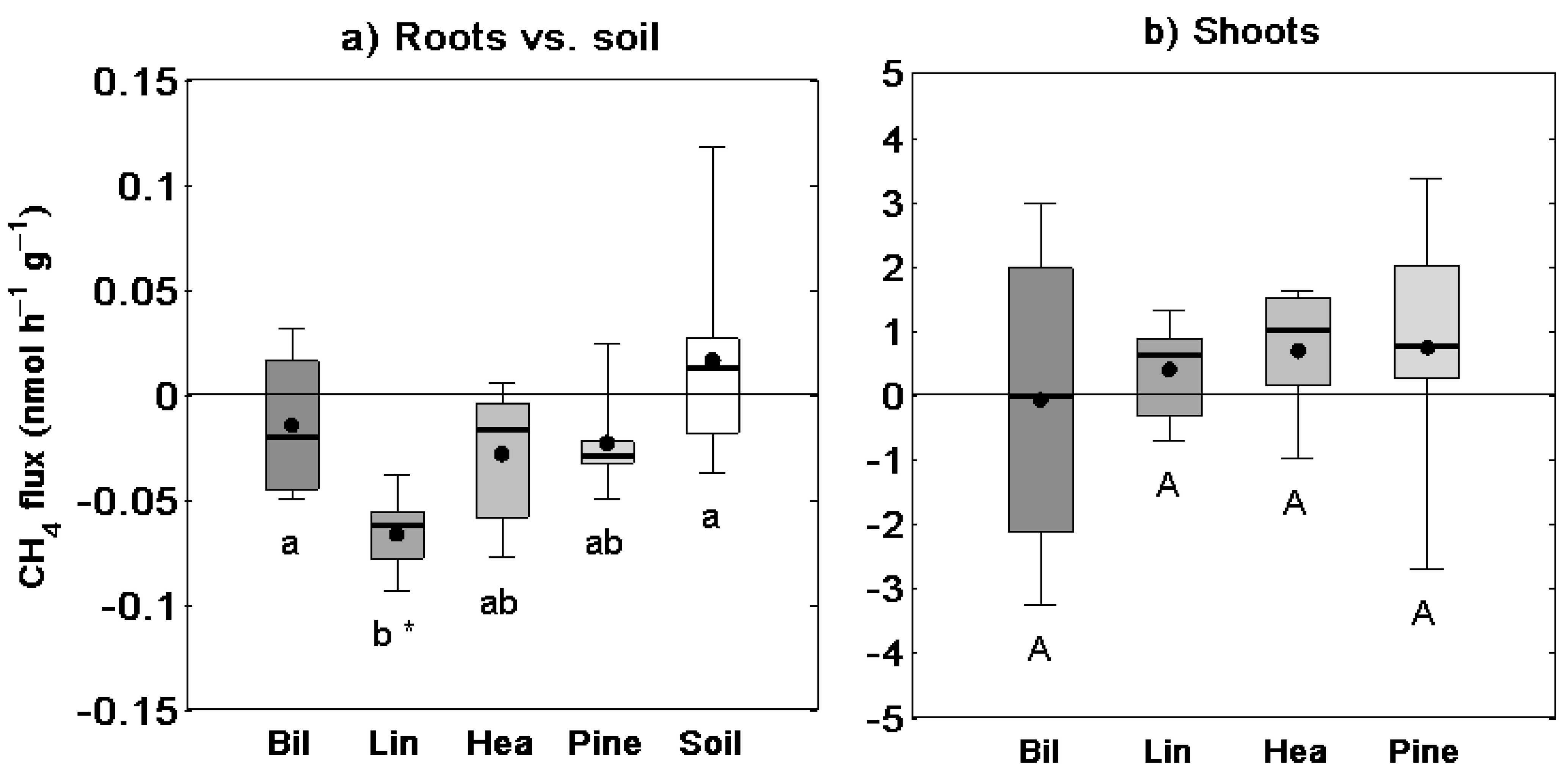

Figure 2. Boxplots of CH_4 fluxes in nmol h^{-1} g^{-1} (DW) from the belowground (a) and aboveground (b) compartments. (Bil=bilberry, Lin=lingonberry, Hea=heather, Pine=Scots pine, and Soil=humus soil). Negative fluxes indicate uptake and positive fluxes indicate emission. The bottom and the top of the box represent 25th and 75th percentiles, respectively, the thick line shows the median, the black circle is the mean. The letters indicate statistically significant differences and asterisk shows significant difference from zero ($p<0.05$).

Conclusions

- The results suggest that the plant roots enhance the presence of methanotrophs and thus CH_4 uptake in humus soils, although the differences between plants and soil were not statistically significant.
- Results do not rule out the presence of small methanogen populations. Thus especially in soil samples the detected small CH_4 fluxes were likely of microbial origin.
- The small CH_4 emissions from the shoots might also be due to non-microbial abiotic processes driven by e.g. radiation, although this was not assessed in this study.

References

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