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Stimulation of methane oxidation by CH4-emitting rose chafer larvae in well-aerated grassland soil

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In this study, the impact of rose chafer (Cetonia aurata L.) larvae on net and gross methane (CH4) fluxes in soil from an old permanent grassland site (Giessen, Germany) was investigated. Previous studies at this site suggested the existence of Scarabaeidae larvae-induced "CH4-emitting hot spots" within the soil profile which may subsequently lead to increased CH4 oxidation. The net (soil + larvae) and gross (soil and larvae separated) CH4 fluxes were studied in a 3-month laboratory incubation. Addition of larvae changed the soil from a net sink (-330 $\pm$ 11 ng CH4 kg-1 h-1) to a net source (637 $\pm$ 205 ng CH4 kg 1 h 1). Supply of plant litter to the soil + larvae incubation jars further increased net CH4 emissions. After 11-13 weeks of incubation, the net soil CH4 oxidation was significantly stimulated by 13 – 21% in the treatments containing larvae. Analysis of archaeal 16S rRNA genes retrieved from the hind guts of larvae revealed that the majority of the obtained clones were closely related to uncultured methanogens from guts of insects and other animals. Other sequences were related to cultivated species of Methanobrevibacter, Methanoculleus and Methanosarcina. Hence, Scarabaeidae larvae in soils (i) may represent an underestimated source of CH4 emissions in aerobic upland soils, (ii) may stimulate gross CH4 consumption in their direct soil environment, and thus (iii) contribute to the spatial heterogeneity often observed in the field with closed-chamber measurements. Long-term CH4-flux balances may be wrongly assessed when unexpected, erratic net CH4 flux rates (due to larvae hot spots) are excluded from data sets.