Does soil disturbance result in soil carbon losses? – A case study on bioturbation effects of wild boar

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Paradigm: Soil disturbance causes soil carbon losses

- It is generally assumed that soil disturbance **enhances soil carbon turnover**.
- This resulted in conclusions such as „no tillage enhances soil carbon stocks".
- **Wild boar are grubbing** and disturbing soils.
- Wild boar populations are drastiacally increasing in many parts of the world.
- However, there is **little field experimental evidence** that soil disturbance itself reduces soil carbon stocks on midterm and on long term.

Soil disturbance by wild boar:

Does it lead to enhanced mineralisation?

Objectives

The study aims at quatifying the effect of soil disturbance (bioturbation) by wild boar on soil organic carbon in forest soils on mid-term.

The study shall provide direct experimental evidence from different forest field sites.

Axel Don

Simulating wild boar bioturbation in the field

Bioturbation by wild boar

Simulated bioturbation

We simulated the disturbance from wild boar using a stick.

23 plots in two areas

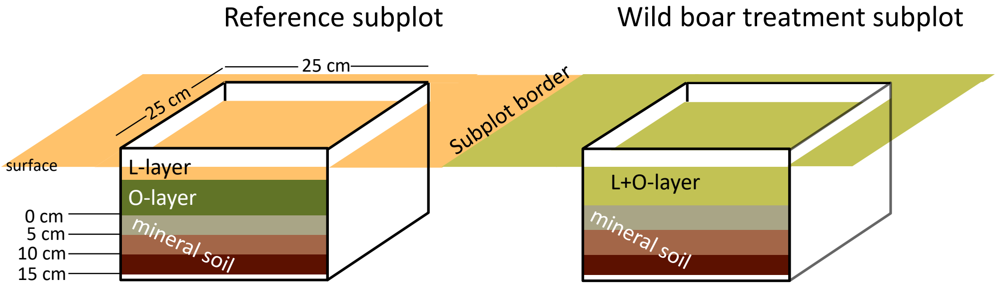
Area Braunschweig
Decidiuous plot

Area Braunschweig
Coniferious plot

Area Eberswalde
Coniferious plot

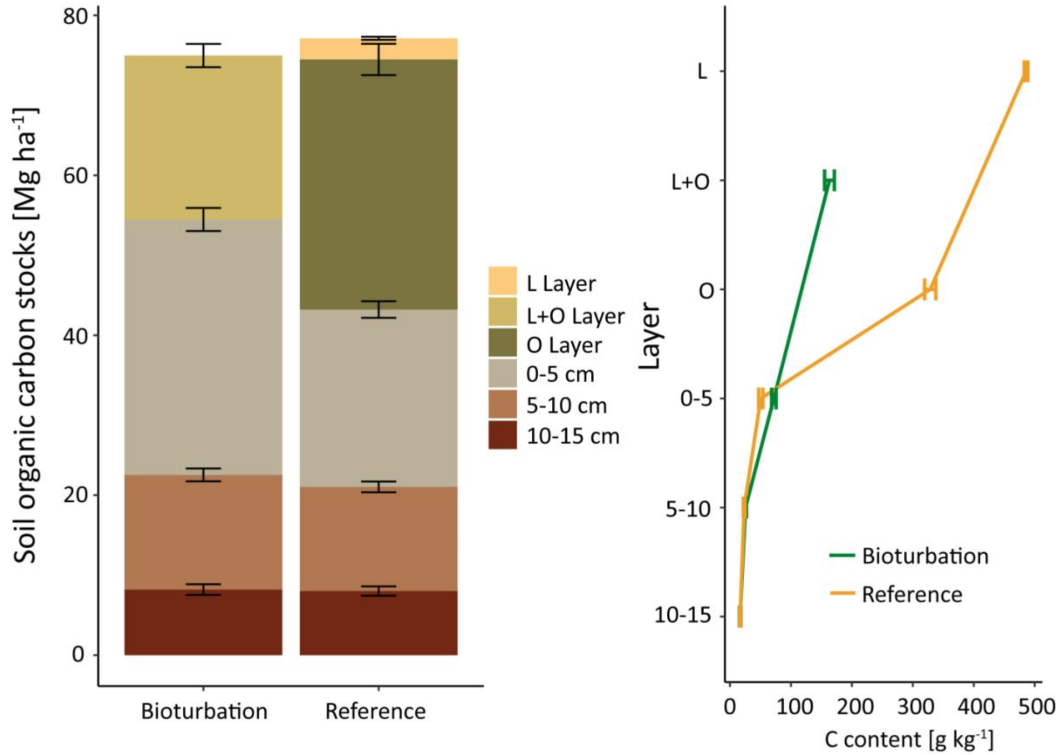
- Each plots consited of a disturbed subplot (right site) and and undisturbed reference subplot (left site).
- At the bioturbation subplots soil was disturbed once per year over a period of six years.

Sampling after 6 years



- ❑ Soils were sampled down to 15 cm depth using 25x25 cm metal frames with 5 replicates per subplot
- ❑ Organic layers were separated
- ❑ Bioturbation plots were sampled mass equivalent to the reference plots (see Don et al. 2019, Biogeosciences)

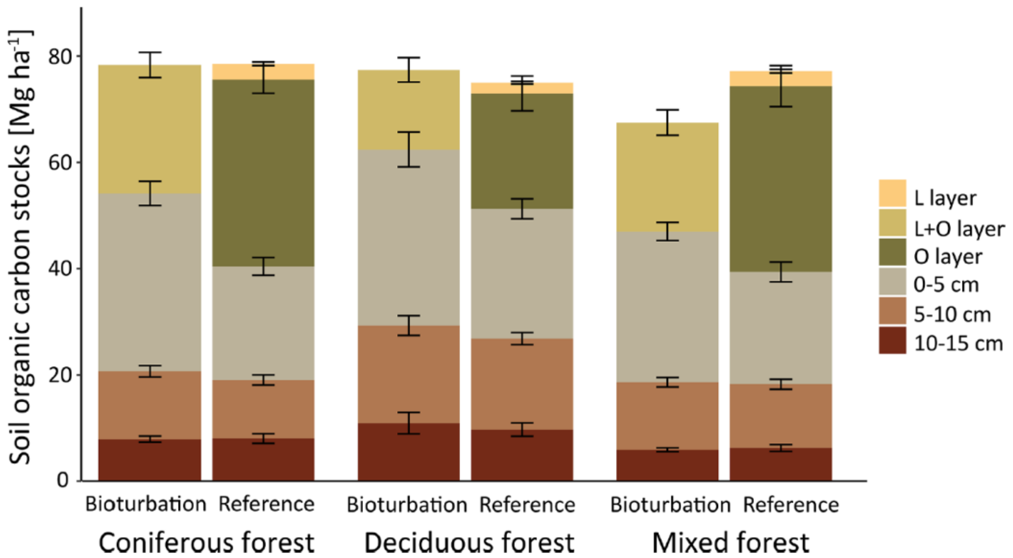
Effect of bioturbation on soil carbon stocks



Don et al. 2019, Biogeosciences

- ✓ Six years of bioturbation did **not** reduce soil carbon stocks in the wild boar treatment plots.
- ✓ Soil organic carbon depth gradients were **less steep** due to the bioturbation (right site)

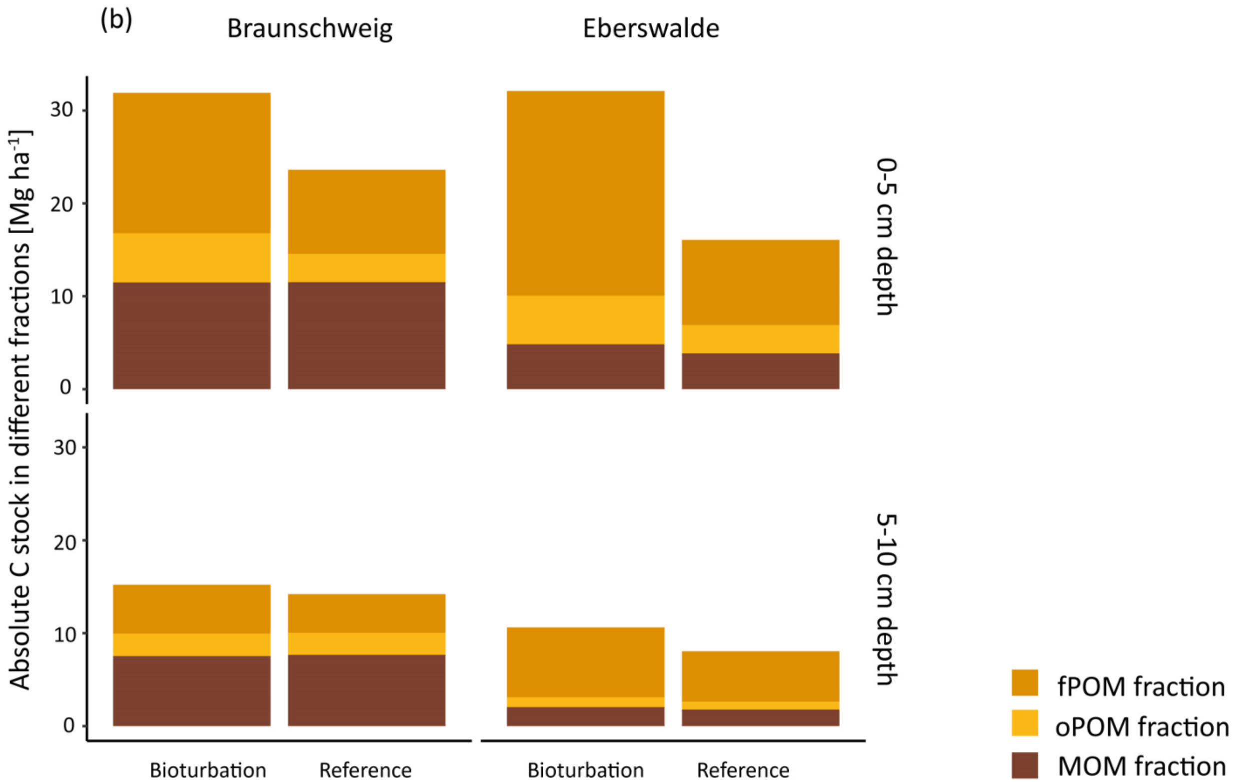
Bioturbation effects in different forest types



- ✓ There was **no difference** of wild boar bioturbation treatements in different forest types.
- ✓ In coniferous forests, deciduous forest and mixed forest bioturbation did not result in soil carbon losses.

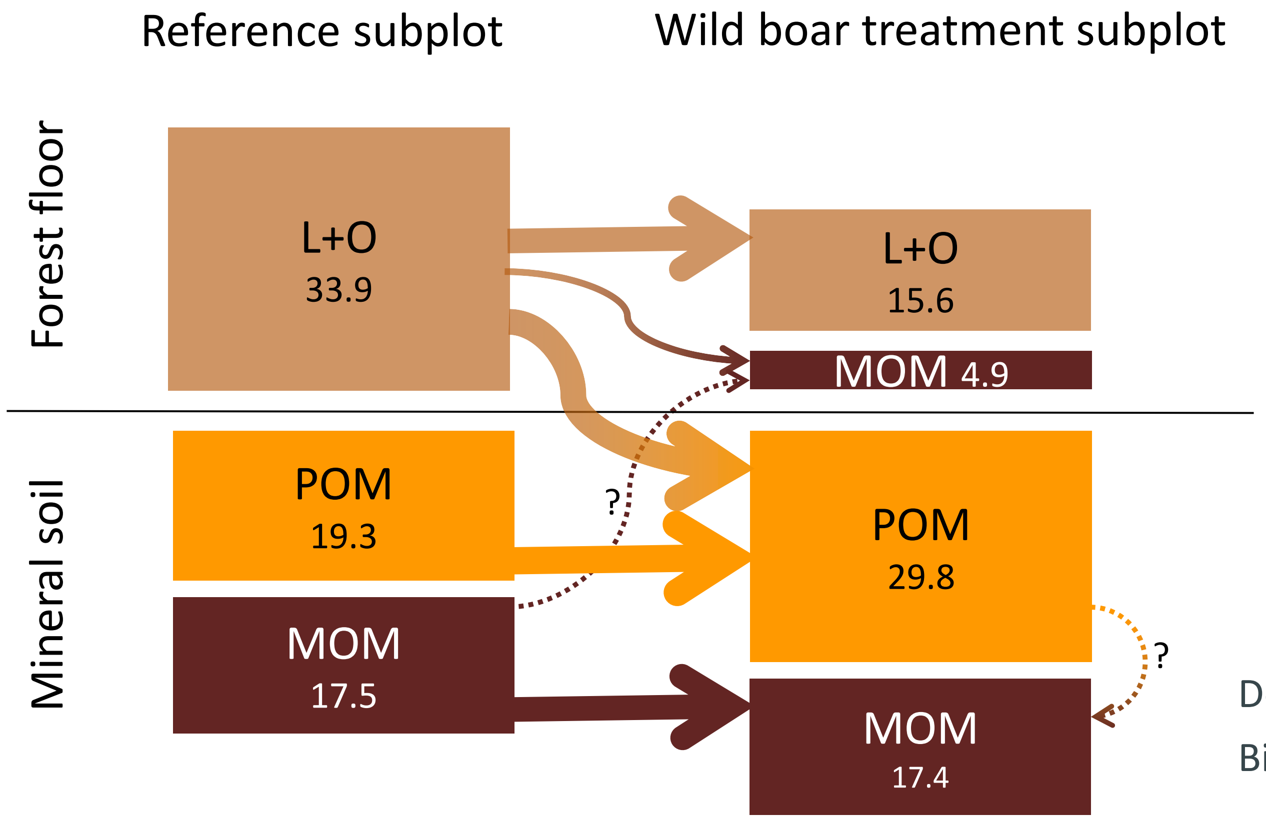
Don et al. 2019, Biogeosciences

Carbon fractions in the mineral soil



- ✓ There was **more particulate organic carbon (POM)** in the mineral soil due to bioturbation.
- ✓ Mineral associated organic carbon (MOM) in the mineral soil did **not change** due to bioturbation

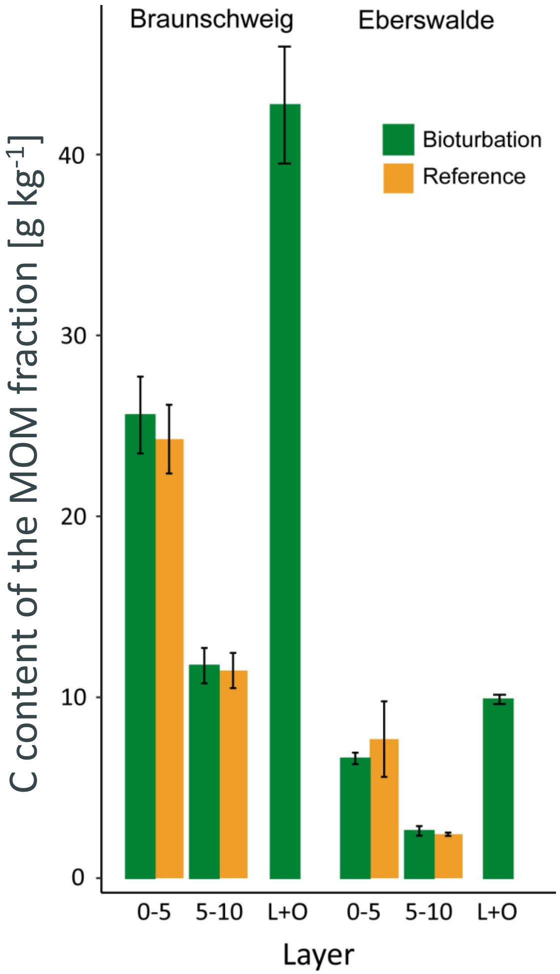
Summary carbon flow



Don et al. 2019, Biogeosciences

- ✓ Parts of the organic layer ended up as particulate organic carbon (POM) in the mineral soil.
- ✓ **Additional carbon was stabilised** as mineral associated organic carbon (MOM) in the forest floor.

C saturation of mineral surfaces?



- ✓ Bioturbation increased the C content of the mineral associated carbon fraction.
- ✓ The was no evident carbon saturation of mineral surfaces, even though the soils were sandy
- ✓ Bioturbation did increase the stabilised mineral associated carbon.

Conclusions

- ❑ Bioturbation did not result in soil carbon losses.
- ❑ In contrast, soil carbon was stabilised, e.g. via moving carbon from the forest floor to the mineral soil.
- ❑ The paradigm that soil disturbance leads to soil carbon losses has to be reconsidered.

For more details see Don et al. 2019, Biogeosciences 16, 4145–4155, *https://doi.org/10.5194/bg-16-4145-2019*