Carbon storage in soil aggregates and associated earthworms communities in grassland soils along an elevation gradients in the Northern Limestone Alps of Germany

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1 INTRODUCTION

- Carbon storage in **Alpine and Pre-Alpine grassland soils** is regulated by combination of biotic and abiotic processes. An improved knowledge of the relationship between these **stabilization mechanisms** is decisive to recommend **best management practices** for **climate change mitigation.**
- Understanding **organic carbon dynamics** in alpine and pre-alpine grassland soils as **regulated by aggregation**.

2 MATERIAL AND METHODS

- Grassland soils of the northern limestone Alps in Bavaria along an elevation gradient **(595 to 1267 m a.s.l., Fig 1)** Ah horizons, **0-15 cm**, sampling 2016.
- Comparative **analysis OC, and total N** of Bulk soil (Table 1), **distribution of aggregates** and **associated organic carbon** (OC) in aggregate size classes (Fig 2 and 3): large macroaggregates **(> 2000 µm, LM)** – small macroaggregates **(250-2000 µm, SM)** - microaggregates **(63-250 µm, m)** - silt plus clay **(<63 µm, s+c).**
- Analysis of the **different ecological niche groups of earthworms** and determined their **biomass** (Fig 4).

3 RESULTS

- **Higher OC and total N** of Bulk soil in the **higher elevation** (Table 1).
- **Higher % of LM** and associated **OC** in the higher elevation sites (Fig. 2 and 3).
- **Fendt** displayed the **high abundance** and **biomass of earthworms** follow to Graswang and Esterberg (high standard deviations, not allowed us to stablish significant differences between treatments) (Figure 4).
- The largest predominant ecological niche group according to the total biomass of earthworms was ***Juvenil Lumbriscus* spec**.+ endogenous spec. for all elevation sites (Figure 5). Adult endogeic group represent similar percent in all elevation sites (34-35%), however, in **Esterberg** we observed that the percent of **Adult anecic (3.4%)** was lower than **Graswang (19.7%)** and **Fendt (17.3%).**
- **PCA** showed that variables which regulated the aggregate formation in Alpine and pre-alpine sites were associated in two main groups: (i) **Biotic factors**: promoved LM formation and (ii) **Abiotic factors:** promoved SM, m, ans s+c formation.

- In OC-rich grassland soils of the Alps high aggregate stability depends on the carbonate content, clay particles and SOC.
- At low elevations earthworm biomass and the aboveground plant biomass are important factors facilitating aggregation

SCAN ME

Esterberg (1267 m)
Phaeozem

MAP (mm) = 1797,
MAT(°C) = 3.0
pH = 6.1,
BD (g cm^{-3}) = 0.4
Parent material: main dolomite

Graswang (864 m)
Cambisol

MAP (mm) = 1036,
MAT(°C) = 6.7,
pH = 6.8,
BD(g cm^{-3}) = 0.5
Parent material: Ca-content silt and gravel

Fendt (595 m)
Fluvisol

MAP (mm) = 975,
MAT(°C) = 8.3
pH = 5.2,
BD (g cm^{-3}) = 0.8
Parent material: Loamy, clayey sediment

Soil depth	Fendt	Graswang	Esterberg
OC (mg g^{-1})			
0-5 cm	60.6 ± 7.8 C	134.0 ± 6.5 B	189.0 ± 6.2 A
5-15 cm	35.0 ± 2.8 B	116.2 ± 1.1 A	129.8 ± 12.4 A
N (mg g^{-1})			
0-5 cm	6.6 ± 0.5 B	12.4 ± 1.8 B	18.9 ± 2.7 A
5-15 cm	4.2 ± 0.4 B	10.0 ±1.3 AB	13.8 ± 2.9 A

Table 1. OC, total N and C:N ratio of Bulk soil at 0-5 and 5-15 cm soil depth in grassland of Fendt (595 m a.s.l), Graswang (864 m a.s.l), and Esterberg (1267 m a.s.l).

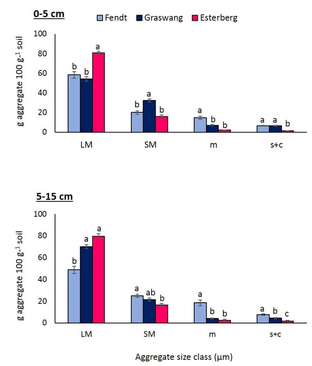

Figure 2. Water-stable aggregate size distribution (g aggregate 100 g^{-1} soil):

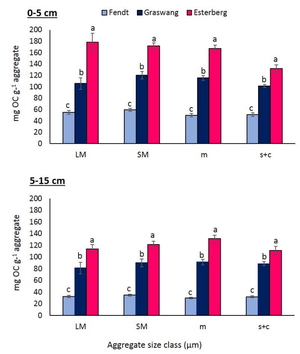

Figure 3. Organic C concentrations (mg g^{-1} aggregate) of aggregates

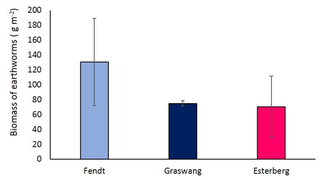

Figure 4. Biomass of earthworms (g m^{-2}) of earthworms

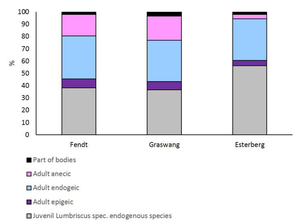

Figure 5. Dominance of ecological groups (biomass) for the sampling sites

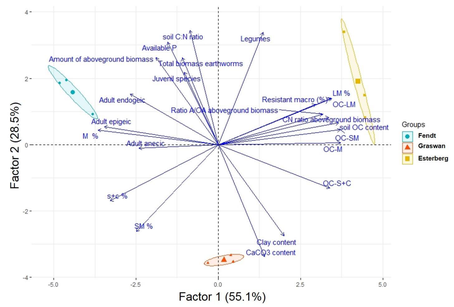

Figure 6. Principal Component Analysis