CLIMOSEQUENCE APPROACH TO MONITOR THE EFFECTS OF EXPOSURE AND ALTITUDE ON PHYSICAL, CHEMICAL AND MICROBIAL PROPERTIES OF ALPINE SOILS

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Introduction

Alpine soils are complex ecosystems characterized by a high variability in climatic conditions and composition/activities of soil macro and microorganisms. The thermal conditions are expected to influence the principal biogeochemical soil processes with implications on ecosystem functioning and soil microbial biodiversity. Up to now, little is known about the effect of microclimate on soil properties in Alpine areas.

Aims

» To evaluate how the soil properties (physical, chemical and microbiological) change along a climosequence approach in function of exposure and altitude.
» To determine the correlations among the different soil properties under this scenario.

Material and Methods

Study area

Val di Rabbi – Val di Sole, Trentino Alto Adige, Italy) in function of:

- **Altitude** (1000-2600 m a.s.l.)
- **Exposure**

North	**South**
(N1-N4 forests; N5 grassland; paragneiss)	(S6-N9 forests; S10 grassland; paragneiss)

Sample collection: August 2012

For each site: 5 soil sub-samples x soil depth (0-5, 5-10, 10-15 cm) x 3 plots (5x5 m, separated 50 m from each other) =

450 SOIL SAMPLES

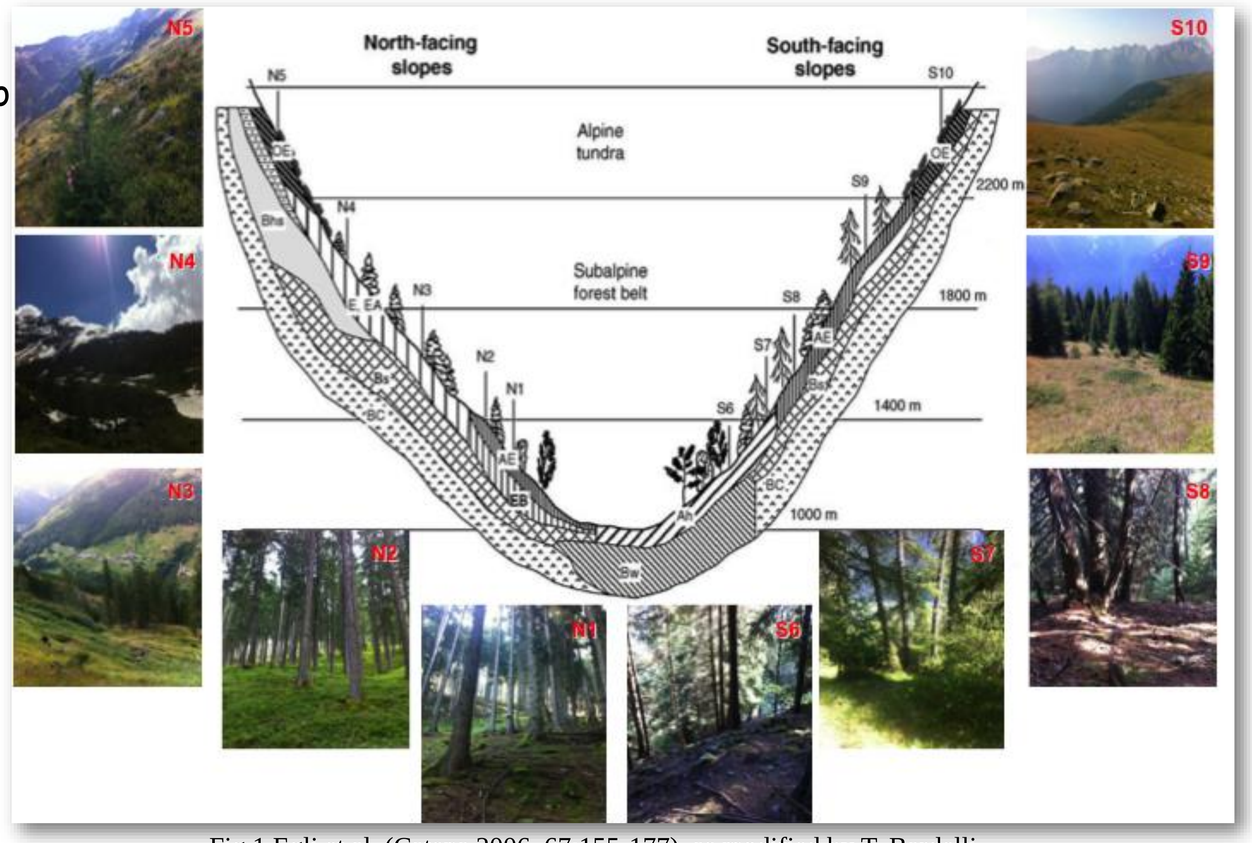

Fig.1 Egli et al. (Catena 2006, 67:155-177), as modified by T. Bardelli.

Methods

✓ Physical parameters (i.e., texture, bulk density)

✓ Chemical parameters (i.e., pH, total C and N, C/N)

✓ Microbial parameters (i.e., eight enzyme activities, dsDNA as index of soil microbial biomass *)

* Crude dsDNA (Fornasier et al., 2014) VS. Pure dsDNA (Ascher et al., 2009)

Results

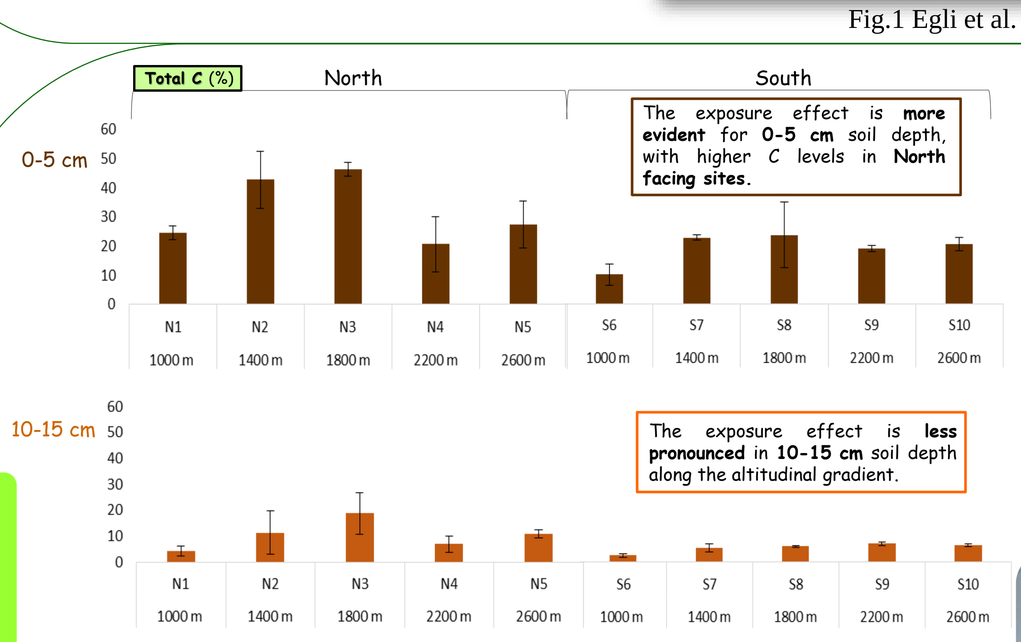

Fig.2 Total carbon in ten sites in function of altitude, exposure and soil depth.

* Crude dsDNA: reliable estimator of soil microbial biomass! Pure dsDNA: -34% DNA loss with purification, underestimation of soil microbial biomass.

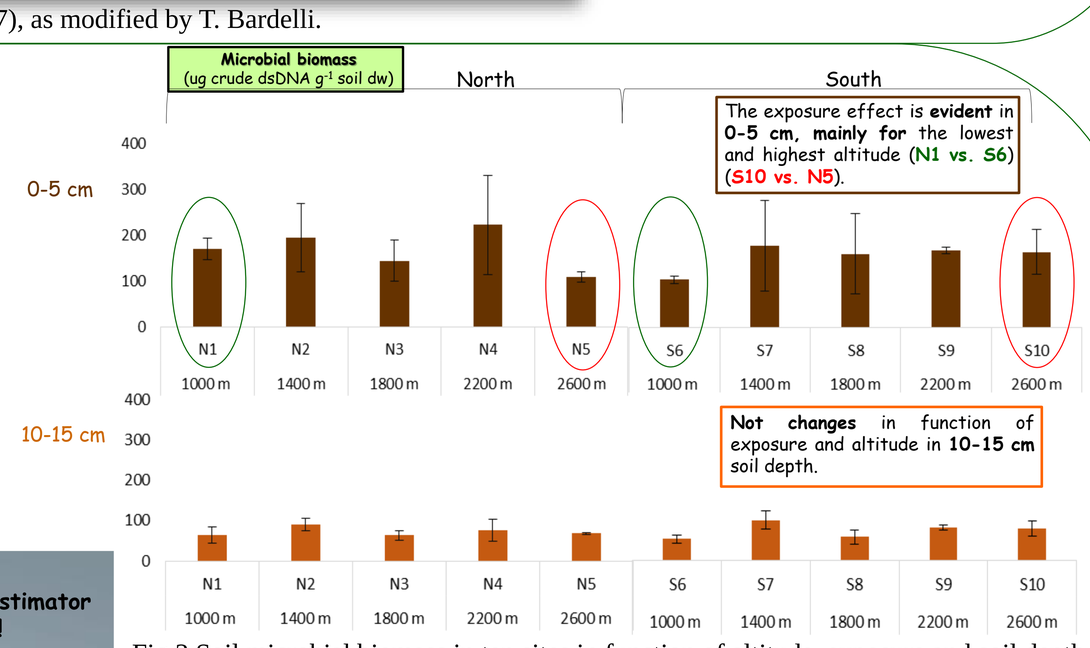

Fig.3 Soil microbial biomass in ten sites in function of altitude, exposure and soil depth.

Tab.1 Pearson's coefficients matrix of soil chemical and microbial parameters.

	pH	Total C	Total N	C/N	Arylsulphatase	β Glucosidase	Acetate esterase	Chitinase	Leucine aminopeptidase	Acid phosphomonoesterase	Alkaline phosphomonoesterase	Pyrophosphate phosphodiesterase	Crude dsDNA
pH	1	-0.487	-0.370	-0.493	0.278	0.030	-0.023	0.219	0.286	-0.140	0.511	0.488	0.088
Total C		1	0.941	0.563	-0.082	0.560	0.196	0.446	0.399	0.517	0.224	0.212	0.559
Total N			1	0.307	0.149	0.642	0.343	0.548	0.526	0.629	0.365	0.381	0.669
C/N				1	-0.481	0.137	-0.132	0.091	-0.015	0.090	-0.136	-0.170	0.083
Arylsulphatase					1	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	0.431
β Glucosidase						1	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	0.778
Acetate esterase							1	n.c.	n.c.	n.c.	n.c.	n.c.	0.439
Chitinase								1	n.c.	n.c.	n.c.	n.c.	0.767
Leucine aminopeptidase									1	n.c.	n.c.	n.c.	0.757
Acid phosphomonoesterase										1	n.c.	n.c.	0.635
Alkaline phosphomonoesterase											1	n.c.	0.725
Pyrophosphate phosphodiesterase												1	0.750
Crude dsDNA													1

p > 0.1 | p ≤ 0.05 | p ≤ 0.01 | p ≤ 0.001

Significative correlations: Total C & N ⇄ Crude dsDNA ⇄ Enzymes activities

** the different color depends on the significance level; (n.c.) is not calculated.

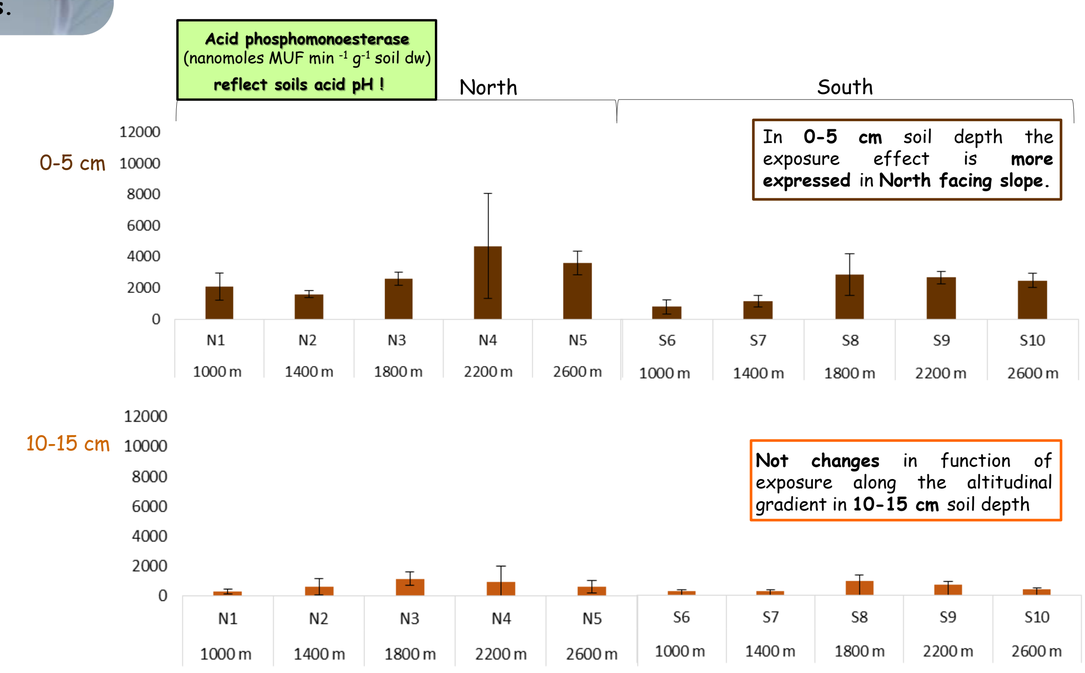

Fig.4 Acid phosphomonoesterase in ten sites in function of altitude, exposure and soil depth.

Summary and Conclusions

Δ North facing sites are characterized by a highest C content and a higher acid phosphomonoesterase activity, in agreement with pH value. It appeared that exposure has a strong climatic impact. Changes in soil microbial biomass are dependent on the study site. Soil depth also influenced on the studied parameters.

Δ Microbial biomass was correlated with all enzymes activities, which are commonly used as indicators of ecosystem functioning.